THE

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	Page
1907	1
Workmen or Shareholders' Interests?	2
The Influence of Electricity on the Mining Industry	2
Steam Pipe Systems for Generating Stations	3
The Earth-Potential Method of Fault Finding (*illus.*)... ...	4
Correspondence:—	
Localisation of Faults on D.C. Mains; Westinghouse-Bremer Patents; Looping-In *v.* Joint Box; Production of Energy from Peat; Gas *v.* Electricity; A Cheltenham Contractor Annoyed; Series Arc Lamps	4 and 5
Proceedings of Institutions:—	
The Commercial Aspect of Electric Power Supply (*illus.*)	5
Automatic Cab-Signalling on Locomotives (*concluded*) ...	8
Notes on the Proposed Home Office Regulations	9
Electrical Exhibits at the Paris Motor-Car Show (*illus.*) ...	10
New Electrical Devices, Fittings, and Plant (*illus.*)	11
Parliamentary	12
Recent Exhibitions:—	
Physical Society of London (*illus.*) (*concluded*)	13
Business Notes	14
Canal Excavation by Electric Power (*illus.*)	19
The Waipori Hydro-Electric Plant, New Zealand (*illus.*) ...	20
An Electrically-Driven Portable Cable Winch (*illus.*)	22
Notes	24
City Notes	27
Stocks and Shares	29
Market Quotations	30
Electric Tramway and Railway Traffic Returns	30
Share List of Electrical Companies	31
Metal Market.—Fluctuations in December, 1907	33
Reviews	33
The Canal Inquiry.—II.	35
Great International Exhibitions (*continued*)	37
Pulverised Coal and its Industrial Applications...	38
Transformer Troubles	39
New Patents Applied For, 1907	40
Published Specifications	40

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1908 EDITION

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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1907.

A RETROSPECTIVE glance at the electrical doings of the past year is not encouraging. It has been, in fact, a very flat, stale and commonplace period in electrical history. The one redeeming feature, perhaps, has been the rapid development of the metallic filament lamp; the tantalum lamp, it is true, had led the way two years before, but 1907 may claim to have been especially noteworthy for the arrival on the open market of quite a number of its rivals, and the electrical world is looking forward to great things from the high efficiency of the metal filament. Once more we may comment on the tendency towards reversion to a primitive type; for was it not the result of experiments with platinum filaments that the carbon filament was originally devised?

The electrical equipment of the new Cunarders marks a great advance in the use of electricity on board ship; electric elevators, telephone exchanges, &c., have now found a place there, and, indeed, the internal economy of a big liner is fast becoming a complex electrical installation—even the propellers are driven by a type of turbine which owes its evolution almost entirely to its association with electrical engineering.

The commercial development of electrical supply undertakings, which we have kept prominently before our readers during the past year, has received a large measure of attention on the part of central station engineers, with results, in some cases, of great promise. This is a department of the business which ought to be fostered to the utmost. Commercial management has long occupied the premier position in the organisation of railways, tramways, shipping and other businesses which involve the use of highly technical processes and elaborate machinery; so, too, it must be eventually with the supply of electricity, and those engineers will be well-advised who take advantage of every means to equip themselves to act in the dual capacity of commercial manager and technical director, with equal efficiency in each of these *rôles*. Otherwise, the engineer, who loves his calling not wisely but too well, and refuses to attach due importance to the commercial aspect of his business, may find himself in a subordinate position.

Turning to electric traction, we may note the completion and opening of two new electric tube railways in London during the year; the Brighton Co. has at last begun the equipment of its system for electric traction, and the other single-phase project—that of the Midland Co., at Heysham—is making rapid progress. The year has again been marked by several runaways on electric tramways, and the subject of efficient braking has been receiving very close attention, but no authoritative pronouncement has yet been made.

In telegraphy, the chief events have been associated with the wireless system: the Berlin Convention has been considered and ratified, and the Marconi Co. has commenced a commercial service between the United Kingdom and Canada,

thus providing another valuable means of communication between the Mother Country and her premier Colony. On the other hand, satisfactory communication has been opened on the Poulsen system between England and Denmark.

In telephony, the most noteworthy event has been the adoption of the measured-rate system by both the Post Office and the National Telephone Co. Great advances have been made in wireless telephony.

Regarding the electrical trade in general, while it is true that the imports and exports, as indicated by our monthly returns, have shown a marked improvement, there is undoubtedly great slackness in the industry, and keen competition continues with unabated severity. We shall deal with this subject at greater length on a future occasion. Proposals for co-operation have been put forward, but have not excited any great enthusiasm in electrical circles, and we fear that the personal element bulks too largely in the latter to permit of the greatest good of the greatest number being readily attained. We trust, however, that in spite of unfavourable indications, things may take a turn for the better in the New Year.

Workmen's or Shareholders' Interests?

We hear so much nowadays of the social welfare of the working man that it is somewhat refreshing to learn what seems to be a new doctrine in the form of a social policy for shareholders in the undertakings of large manufacturing companies. Meetings of electrical companies in England are not always free from the complaints of shareholders, on the ground of very low dividends or of the absence of divisible profits, but where the distribution is satisfactory, no one grumbles, and that is an end of the matter. But apparently a new principle is suggested in Germany, seeing that at the recent annual meeting of the Allgemeine Co., in Berlin, a shareholder proposed that the directors should pursue a social policy, not so much in the interests of the workmen as in those of the proprietors.

As the company declared a dividend of 12 per cent. on a share capital of £5,000,000, the proposal did not receive serious consideration, but it has subsequently occupied attention in other quarters, as a result of the dissatisfied shareholder's taking advantage of the publicity afforded by the newspapers. The proprietor in question holds that the shareholders take all the risks and receive little in return, whereas the workmen, especially in periods of good trade, always enjoy higher wages, and also have the benefit of increasing outlay incurred by the companies for the social well-being of the men. But he is answered by the argument that the welfare of the workers is bound up with that of the shareholders, and that if low wages are paid the workmen are inferior, and cause financial loss by damage to machinery and waste of materials, so that the payment of lower wages would not be of any more benefit to the shareholders in the long run than the continuance of good wages. We will not, however, pursue this delicate problem any further, but will draw attention to an entirely different view, which was also advanced at the Berlin meeting.

In this particular case other shareholders brought forward the question of the pay and treatment of the company's employés, and contended that the applications of officials for increases in salaries or extra pay during a period of greater cost of living had been refused. The claims of the officials for an improvement in their condition were warmly advocated by the president of the federation of technical-industrial officials. But Herr Rathenau repudiated these reproaches, and pointed to the company's benevolent institutions and the pension fund, the payment of £350,000 per annum in wages and the granting of Christmas bonuses—everything, in fact, as he remarked, to render the life of the employés endurable. These observations practically settled the social discussion which took place at the meeting. Since then we have had the curiosity to refer to an abstract of the company's accounts, and find that the directors' fees for 1906-7 are recorded as £20,000, as compared with £15,500 in the preceding financial year. On the other hand, the bonuses to employés amount to £30,000 and £25,000 in the same years respectively, whilst the allocations to the pension fund also reach £30,000 and £25,000 in 1906-7 and 1905-6 respectively. The problem now to solve is whether the company is not as mindful of the interests of the employés as it is of those of the shareholders, the answer being apparently in the affirmative.

The Influence of Electricity on the Mining Industry.

In spite of the repeated and prolonged eulogies of the American nation in the matter of engineering progress, it is doubtful whether the full force of the influence which electricity has had upon engineering and mining developments in that country has been realised. It must be first of all remembered that the country is favoured by having in conjunction with one of the largest natural waterfalls in the world, a completely equipped and thriving electric power supply industry.

The total hydraulic power of Niagara Falls, if it were all utilised, would be about 3,500,000 H.P.; although nothing like this quantity is at present in use, and although the recent æsthetic outcry has resulted in the restriction of the power to be diverted for manufacturing purposes, it will yet be seen what a tremendous potentiality the neighbourhood of these Falls has, as the seat of manufacturing processes depending on electricity. It is interesting, therefore, to note along what lines development has gone.

The electro-chemical industry is one of the most flourishing of the Niagara group, and owes its origin and growth almost entirely to the development of the Falls. A glance at the Patent Office record of America will reveal the extraordinary variety of the chemical processes which have been developed along electrical lines.

The effect of electricity on the chemical industry cannot be gauged in horse-power or in tonnage of output, inasmuch as this industry is still in the early stages of development.

A mere recitation of the chief branches of the electro-chemical industry gives some little idea of the vigorous nature of its growth. The caustic soda and potash industries have been revolutionised; aluminium has been transformed from a rare metal to a common commercial product; the calcium-carbide industry is entirely an electrical affair, and dependent on this is, of course, the commercial production of acetylene. Before the introduction of electro-chemical processes, the markets of the world were being ransacked for graphite and emery, the natural deposits of which were being rapidly depleted. Flourishing industries are now situated at Niagara, for the production of artificial products of this description, together with the cognate manufacture of carborundum.

Not only in the Niagara Falls district is the enormous potency of electricity apparent. The State of Pennsylvania is, as is well known, the American coal-bearing district, and the problem facing the United States was to get coal at rates which would not only enable them to supply home markets, but to ship to Europe in face of British competition. This problem has been successfully solved by the application of electrical energy. The Pennsylvania soft coal is got by driving adit levels into the hills, and the slack coal obtained from the mine is used to drive a steam-electric generating plant. The levels are lit electrically, thus saving expense in oil and candles. Electric coal-cutters are in use, enabling a man and boy to get out as much coal as six ordinary men; electric trolleys bring out the coal trucks;

the coal is automatically graded, weighed and shot down into railway trucks, one row of trucks receiving house coal, the next steam coal, and the third slack. The total cost of mining, weighing, grading, and putting into trucks for transit to any part of America, with a margin of profit, is only 3s. 9d. per ton.

Iron is often found in connection with coal seams, and America again furnishes a noteworthy example of the application of electricity to mining in the Edison Mine. Here everything, from blasting, digging, and trucking, to the reducing process, is done by electricity. Before the reducing process the ore is crushed fine, and by passing it between electro-magnets the dirt is separated from the metallic particles, the residue being almost pure ironsand, perfectly easy to manipulate and turn into steel ingots.

The above are some indications of the way in which in America electricity has exercised an influence on the treatment of the raw products of the earth. In Great Britain a certain amount of conservatism is naturally to be expected, although the same methods are being, to a certain extent, applied, but it is in our colonies in their comparatively undeveloped state that the lessons taught by America will probably be most extensively adopted.

A writer in the *New Zealand Mines Record*, after reciting some of the above facts, proceeds to draw the deductions which apply to mines and manufactures in that country. He points out that in New Zealand there are quantities of bauxite, from which aluminium can be extracted, and the time must come when the aluminium industry will be a staple one in that country. The iron deposits are at Parapara and Whangarei; and other places only await sufficient consumption to warrant extensive works and large production. In the future the latter locality will probably be the Birmingham of New Zealand, but it will have to be through the agency of electric power. At present the cost of obtaining coal in New Zealand is enormous, and the manufacture of iron only waits for a reduction in operating costs to become a leading industry.

The same arguments would apply with even increased force to the great undeveloped continent of Africa, which the genius of the Briton has already bridged with a slender thread of railway communication. The Falls of the Zambesi, and the water-power furnished by other great rivers in the interior, taken in conjunction with the enormous undeveloped mineral deposits of the continent—beside which the exploitations in Rhodesia sink into comparative insignificance—furnish an opportunity for mining and manufacturing expansion, which, as the years pass and development becomes more assured, will probably move the centre of gravity of the manufacturing industries of the world away from the more civilised and played-out continents; and as far as can at present be determined, the chief agent in this revolution will be the application of electrical methods.

Steam Pipe Systems for Generating Stations.

IN writing on this subject in our newest electrical contemporary, Mr. J. H. Rider does not start well in saying that boilers are more liable than engines to stoppage from small causes. There are, of course, boilers and boilers, and this conclusion may have been reached as a result of a poor choice of boilers, but such has not been the general experience of electrical generating stations, which have been by no means free from engine failures. The tendency to-day is to simplify piping by making each engine one with its own boilers, and against this practice Mr. Rider seems to fight somewhat shy, though, in advocating the old system, modified in the direction of simplicity, he adduces somewhat unfortunate examples, to wit, the L.C.C. Greenwich station that is, and the L.C.C. station that was to be up river, and from which London was fortunately freed by Parliament last year.

The existing station has a continuous 12-in. steam main in the engine room, into which, *close together*, enter apparently straight, stiff 8-in. branches from two rows of boilers, of very different lengths. In some cases the two straight pipes appear to differ by about 60 ft., representing an expansion difference of 1·5 in., or 2 in. for superheat, with little provision for meeting it. These two branches should have been further apart. As to the proposed bulk supply station, the 16-in. main seems superfluous. In a station of this size, the coupling of each bank of eight boilers to two generators should have been sufficient to cope with all the probable mishaps from a well-designed set of plant.

No one will quarrel with the author in his falling foul of such double-decked monstrosities as Lots Road station. For the rest, the article is somewhat platitudinous, for it seems to condemn the ring main which has for years been condemned by steam engineers, from Mr. J. S. Raworth onwards, though no credit is awarded; and to advocate the reduction in size of valves as carried out in the Hopkinson-Ferranti valve, no credit again being given to the originator of the idea of smaller valves with conical ajutage, Mr. W. H. Booth, who, however, would not have used equilateral cones but oblique, so as to avoid the water difficulty. Properly made, this type of valve offers no obstruction to the free flow of water.

Finally, on drainage, surely Mr. Stromeyer has practically told engineers how they ought to proceed, for it is a trifle late to be told that water, left alone, will run down hill, or that it may be swept up hill by a tornado of dense steam. Nor can much be said for the advice to put economisers above the boilers. Hot water in cast-iron pipes is ugly stuff for a possible shower bath. The author's own words, "fearful and wonderful," as applied to things he himself condemns, would not be inapplicable to what he appears to put forward himself as good.

It is to be wished that writers on steam would use absolute pressures when comparing pressures and densities. Thus *in re* the comparison of flow at 180 lb. and at 90 lb. gauge pressures—even for this special ratio of gauge pressures the relative densities would probably be found more approximately true on the absolute notation.

The article generally seems to be very much like a paraphrase of various articles that have appeared during the past few years, and to such an extent to be somewhat like cutting off the head of an enemy already slain by forgotten champions, for, especially in regard to the ring main, we thought everyone had heard Mr. Raworth's denunciations. The illustration of the method of supporting the water separator is as good as it probably is original. It affords freedom where much wanted. The reprinted pamphlet of a serial on pipes, that appeared in another electrical contemporary, should be looked up as one of the latest works on pipes by all who wish to shine in this direction.

Disappearance of a Telegraph Engineer.—It is reported in the daily Press that Mr. Tom London, chief engineer of the Telegraph Construction and Maintenance Co., Ltd., of East Greenwich, who had been sent to Mombasa to superintend the laying and repair of cables, left the cable ship with Mr. Ansell, of the Eastern Telegraph Co., for a shooting expedition, and failed to return. Search parties were organised, and the country was scoured, without success; a reward of £100 was also offered, and the Colonial Office took action. Up to December 31st no news had been received, though Mr. London had then been away ten days.

New Barrages in Germany.—Recently the Ruhrthalsperrenverein, an association interested in the construction of barrages in the coal-mining district on the Ruhr River, declined the scheme to construct a barrage in the Kierspi Valley because of the projected great barrage on the Mochne River. The *Deutsche Submissions Anzeiger* of December 19th announces that it has now been decided to proceed shortly with the erection of a barrage in the Kierspi Valley, by means of which 10,000,000 cb. metres of water will be stored. The Government and the provincial authorities will each bear one-third of the necessary expense. Mr. F. Brantzky, of Cologne, has obtained the first prize for the Mochne barrage. Further barrages are to be constructed in the Eulengebirge, and in Bohemia.

D

THE EARTH-POTENTIAL METHOD OF FAULT FINDING.

By W. A. TOPPIN A.M.I.E.E.

When current passes, or is made to pass, from a fault on an underground cable to earth, the ground immediately round this spot is raised to a pressure above the normal. This pressure is easily measured by means of a voltmeter, one terminal of which is connected to an earth plate, water or gas pipe, while the other terminal is connected to a wire which has the other end touching the ground in the vicinity of the fault. The application of this method to the localising of faults on the outers of three-wire networks was described in the Electrical Review, of October 25th, 1907.

I now propose to show how this method may be applied to the localising of short-circuits on three-wire networks, faults on two-wire networks d.c. or a.c., and traction feeders, provided that current can be passed through the faulty cable to earth.

In the case of short-circuits between two or more conductors, the excessive rush of current will probably break down the insulation of one of the conductors to earth. If this has not already happened, another short application of current to the fault will most likely do so. An example of this type of fault recently located by this method will prove its usefulness. All three conductors of a distributor were burnt completely through by a heavy short-circuit. A bank of lamps was connected to a live feeder and connected in turn to each of the six ends, two of which were found to allow a small current of about 3 amperes to pass to earth. One of these was connected up through the lamps to the live main, and the fault was quickly and accurately located.

A fault on a neutral conductor is found in the same manner. Disconnect both ends of the cable in question from the mains, and feed into it from a live main through lamps.

Coming now to two-wire systems not normally earthed, the particular length of conductor on which there is a fault is found out in the usual manner, if it is not already known. If it is preferred to test without interrupting the supply, make the connections shown in fig. 1. Supposing the fault to be on the negative side of the system, the positive side must be earthed through a resistance in order to make the negative side have a pressure below earth. This earth connection may conveniently be made at the generating station, but this is not essential as any convenient point of the network will answer just as well. Current will now pass from the positive earth plate to the negative fault, the amount varying according to the resistance of the fault and the resistance inserted between the positive conductor and earth.

In fig. 2 another method is shown of carrying out the test. The faulty cable is isolated from the network, the opposite

Fig. 1.

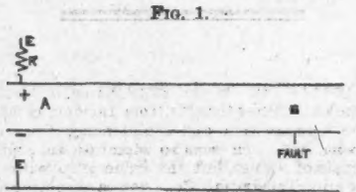

Fig. 2.

polarity is earthed, no resistance being now necessary, and a bank of lamps R is connected as shown in the diagram. A fault on a high-tension feeder may be found out by feeding the faulty section from the generating station or sub-station with direct current supplied from the traction or lighting bus-bars. The writer has known of many cases of fault finding on high-tension cables by means of Murray's loop test where much time would have been saved and trouble avoided by using the method described above.

Dealing lastly with traction feeders, one side of the system is always earthed, and the positive feeders have either a good insulation from earth, a leakage to earth, or a total burn out. Endeavour in the case of the last-mentioned fault to feed from either end of the burnt-out section to earth and test in the usual manner.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Localisation of Faults on D.C. Mains.

In your issue of October 25th you publish a letter on "The Modern Three-Wire Continuous-Current System," by Mr. W. A. Toppin, A.M.I.E.E.

I should be obliged if Mr. Toppin would say if this test could be used on the two-wire system. I have an installation of 80-kw. 220 volts, and have had a lot of trouble by earths on the sub-mains, which are 19/16s 2,500-megohms vulcanised india-rubber and lead-covered, laid in asphaltic troughing, and run in with bitumen. Some I have found with the lead covering fused to the copper.

I should like a description of this test applied to my case, if it is not troubling you too much.

Faults.

[See the adjoining column.—Eds. E.R.]

Westinghouse-Bremer Patents.

Referring to the further statement of Messrs. D. Santoni and Co. (1906), Ltd., we have now received the decision of the Comptroller-General of Patents, referred to in our previous letter, and have, therefore, issued a writ against Messrs. Santoni for infringement of our flame arc lamp patents.

The British Westinghouse Electric & Mfg. Co., Ltd.

London, W.C., *December 28th*, 1907.

Looping-In v. Joint Box.

Replying to Mr. L. Brooke Allis's query as to why I show 1-in. tubing for four 3/20 wires in my diagram, I should state that in the system of which I wrote, the tubing, bends, &c., are first fixed and the wire afterwards drawn in. The outside diameter of 3/20 C.M.A., 2,500-megohm grade Association wire is $\frac{7}{32}$ in., and it is not possible to safely draw four of these wires in a tube smaller than 1 in. Simplex (the 1 in. is, of course, the outside diameter). The diagram also shows that as many as six wires are sometimes required.

As stated in my letter, I do not think the matter is of much importance as regards small contracts. It is in large buildings with long runs, such as warehouses, sheds, stores, &c., where lights are few and runs are long, that the full iniquity of the looping-in system reveals itself. In any case, however, the crowding of the wires into the lamp-sockets is objectionable and dangerous.

J. O. Girdlestone.

London, N.W., *December 24th*, 1907.

Production of Energy from Peat.

Although Mr. Tomlinson will no doubt himself reply to Mr. Erith's criticism on his paper, and no one is better able to do so, I should like, with your permission, to put in a few words thereon.

Mr. Erith says that air-dried peat has only about one-third the heat value of slack coal, and his authority for this assertion is—himself! Now, the result of a series of tests with Irish peat, made at the works of Brunner, Mond and

Co., given me by the Power Gas Corporation, was that 1 ton of air-dried peat produced 87,000 cb. ft. of gas of a calorific value of 150 B.TH.U. per cubic foot = 5,825 B.TH.U. per lb. Three times that is 17,475 B.TH.U. per lb., which, according to Mr. Erith, would be the heat value of slack coal! I wish he would tell us where to get it, and at what price? In the locality, coal of little over double the heat value of the peat costs about 14s. per ton, and with steam engines we should be doing well to get an average of about 10 per cent. thermal efficiency. On the other hand, with gas engines we can get about three times that efficiency, and, as Mr. Lennox has shown, we can get the peat at a cost of about 2s. 6d. per ton, delivered to the producers. I need not trouble you with any further comment on Mr. Erith's letter.

J. Sturgeon, M.Inst.C.E.

Whitkirk, near Leeds,
December 23rd, 1907.

The genesis of Mr. Erith's letter on the above subject in your issue of December 20th, I take, from internal evidence, to have been somewhat as follows:—

Five minutes given to the rapid perusal of my address. Five minutes to the evolution of a scheme of utilisation of the waste heat. Five minutes to some extremely inaccurate figuring on this scheme of his own devising—and then the letter.

Mr. Erith's condemnation of his own scheme of heat utilisation does not concern me; but when he proceeds to state dogmatically that "the only way to get this drying effect is to burn about half of the dried product of the dryer furnace," it does concern me.

The simple arithmetic of the case is this:—1 lb. of chemically dry peat combined with 2·3 lb. of water, is 70 per cent. peat—*i.e.*, peat containing 70 per cent. of water; 1 lb. of chemically dry peat combined with 0·8 lb. of water is 45 per cent. peat. To dry, therefore, from 70 per cent. to 45 per cent. requires the evaporation of 1·5 lb. of water per lb. of chemically dry peat containing 8,644 B.TH.U., of which 50 per cent., or 4,322 B.TH.U., are available for the purpose, about 40 per cent. in jacket water and 60 per cent. in exhaust gases.

I am quite certain that this heat *properly applied* is quite adequate to the duty; in fact, recent investigations lead me to believe more than adequate.

Mr. Erith estimates that it is only equal to the evaporation of 0·15 lb. of water. This strange conclusion is arrived at from two premises:—

1. That the cooling water "is utterly useless for drying purposes."

2. The waste gases are the product of an incomplete combustion, and, therefore, of trifling drying value.

Both are wrong; the latter doubly so.

Thomas Tomlinson.

Dublin, *December 23rd*, 1907.

Gas v. Electricity.

I have been very much interested in the article in your issue of the 13th inst., headed "A Gentle Reminder." Your contributor is quite correct in the major portion of his arguments, but I should like to point out that there is one thing which he has omitted, to which supply engineers should devote their attention: that is, the reduction of the cost of generation. The new incandescent lamps will reduce the cost of lighting, by reason of the increased efficiencies of lamps, but at the present time electricity is at a great disadvantage in its struggle with gas, on account of the much greater cost. Except in special cases, such as those of the new incandescent lamps, with anything that may be done, either by electricity or by gas, lighting, heating and power, the cost by gas is on an average about half that by electricity. The great convenience of electrical apparatus will always command a higher price for it, but there is a figure, beyond which even the most enthusiastic users will not go, and there is still a wide margin between that and the cost of gas. Further, the cost of gas tends steadily to decrease, and should the absurd restriction, under which gas has laboured for so many years, and which obliges them to make their gas of certain materials, be removed by Act of Parliament, as it very probably will be before many years are passed, the cost of gas will be still further reduced, so that electricity has a very long difference to make up. I suggest that electrical engineers would be wiser to employ their time in attacking the problem of decreased cost, than in throwing stones at gas, which is what the great majority of them are doing. They are throwing the stones, and gas is making the running.

Sydney F. Walker.

Bath, *December 24th*, 1907.

[We do not agree with our correspondent's statements regarding costs.—EDS. E.R.]

A Cheltenham Contractor Annoyed.

I fear I omitted to state that the price £1 10s. includes hire of lamp transformer, carbons and carboning, and breakages, for 12 months. If corporations can make it pay, the contractor may at once close up. And if these arc lamps are hired for the purpose of getting current consumed, it would be better to say so at once, as it is preferential charging.

Still Anxious.

Series Arc Lamps.

Would some of your readers kindly inform me of the easiest (or any good) way of finding out which is the faulty arc lamp when a line of them begins jumping, all together, through some defect or want of adjustment in one? Changing the lamps one by one is, from time and other considerations, often impossible.

I may mention that I am a practical electrician, accustomed to testing instruments and the general mechanism of arc lamps.

Linkman.

PROCEEDINGS OF INSTITUTIONS.

The Commercial Aspect of Electric Power Supply.

By W. B. WOODHOUSE, Associate Member.

(*Abstract of Paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Leeds, December 19th*, 1907.)

A GLANCE at the history of electricity supply in this country shows that in the beginning the business was built up entirely on the basis of supply in isolated areas, the boundaries of which, for the sake of convenience, were made coincident with those of parishes or other administrative districts.

The electric lighting business developed along the definite lines laid down by the framers of the early Acts, but the growth of the use of electric power for urban tramways and for general purposes, considerably altered the working conditions of the existing supply stations. In the recommendations of Lord Cross's Committee of 1898, the benefits of supply over a large area and the damaging effect of the veto and powers of purchase possessed by local authorities were recognised; the first batch of Power Bills was considered in 1900 by a Committee presided over by Lord Airedale (then Sir James Kitson), and the declaration of that Committee as to the lines on which clauses were to be settled marks an important step in the progress of electric power supply. Prejudices die hard, however, and the local authorities devoted their energies to the crippling of power supply by the insertion in Power Acts of restrictive clauses.

In 1902 our Institution marked its sense of disappointment with the state of affairs in the resolutions of March 25th, but it is lamentable to state that legislation on this matter is yet unaltered. While the legislative changes mentioned above were being made, the technical problems of electricity supply had also changed in a remarkable degree. The growth of the demand for electricity for power purposes has led to the adoption of larger generating units, which has facilitated distribution over a larger area at high pressure, and the economy of the large generating station—and inferentially the uneconomy of small stations—is now an accepted fact.

The argument for centralisation is—

1. Reduced capital expenditure per kilowatt of generating plant due to increased size of units.

2. Increased efficiency of plant.

3. Improved load factor due to diversity of requirements and demand.

4. Reduced wages and management charges.
5. Small proportion of stand-by plant.

Against which must be set the disadvantages of:—

1. Extra capital expenditure on transmission.
2. Losses in transmission and conversion.

Practice has shown that the small generating station cannot produce electricity at a price sufficiently low to enable it to be supplied to power users at a competitive price. A station of 1,000 KW., for example, cannot hope to supply a power user requiring 300 KW. as cheaply as the power user can generate for himself. Assuming the power user's load factor to be equal to that of the supply station, the author's experience is that the limiting size of a consumer's installation, which can profitably be supplied from the central station, is from one-tenth to one-fifth the capacity of the station plant.

As, however, the size of the generating station is increased, the advantages of centralisation come into fuller play, although to some extent counterbalanced by the increased capital expenditure on distribution and by the increased losses. There is a limit to the economical radius of distribution, and, therefore, to the size of the generating station required. It does not appear that there is any limit to the size of the generating station on the score of efficiency and cost per kilowatt.

To take round figures, the capital cost of generating stations of various size is as given in Table I.

TABLE I.

Capacity of station.	Cost per kilowatt.	Relative cost per cent.
60,000 KW.	£10	100
6,000 KW.	£15	150
600 KW.	£20	200

That is to say, if 100 consumers each requiring 600 KW. combine together in a joint station, the total capital expenditure on generating plant would be one one-half of that required for isolated plants.

The improvement in efficiency due to the use of large units may be seen by considering some typical figures of turbine steam consumption (Table II). To the full load test figures the author has

TABLE II.

Size of generating set.	Test figures. Full load consumption in lb. per kilowatt-hour.		Working figures. Estimated coal consumption.	Working figures. Relative cost per cent.
	Water.	Coal.		
3,000	15	1·875	3·125	100
600	20	2·500	4·160	133
300	24	3·000	5·000	160

added an estimate of the average working figures in stations with a load factor of 25 per cent. It will be seen that the coal consumption of the smallest unit is 60 per cent. in excess of that of the largest.

Supply over a large area brings with it the supply to power users with diverse requirements—lighting, traction, general power users and collieries, for example, each have different hours of use, and in each case the peak load occurs at a different hour in the day.

TABLE III.

Item of cost.	Load factor. 15 per cent.	30 per cent.	60 per cent.
Coal	100	70	55·0
Wages	45	25	12·5
Stores	10	8	6·0
Repairs	50	40	30·0
Total	205	143	103·5
Relative cost per cent. ...	198	138	100

Experience shows that the station demand will not exceed one-third of the total lighting connected to the system, nor one-half of the power installed by power users, and that if the individual maximum demands of a number of power users be added together, that figure will be from 50 to 100 per cent. in excess of the demand at the generating station, with a consequent improvement of the load factor.

As to the saving in wages and management charges in the larger station, this depends on so many variables that general figures are not of great value. Since, however, one man can attend to a 3,000-KW. set as well as he can to a 300-KW. set, the saving is obviously considerable. The effect of load factor on works costs is still more important.

Table III is a statement drawn from the author's experience of the effect of load factor on works costs.

Summary of Advantages.—Summarising the advantages of centralisation and the consequent diversity of demand, it will be seen that diversity of demand has effect both on capital and running cost:—

The capital cost of generating plant per kilowatt installed in the large power scheme may be taken at one-half that of a small power station.

The diversity factor will approach two, *i.e.*, the large scheme has the further advantage of requiring only one-half of the plant required by the individual consumers if isolated stations were erected, or, taking the two advantages together, a capital expenditure per kilowatt of demand of one-quarter.

The works costs are reduced both on account of increased size of generating sets and improved load factor, the latter advantage representing a saving of 50 per cent. over the works costs of the average power user.

We may express the total saving due to centralisation by a curve (fig. 1).

It will be seen that before equality of expenditure on isolated and public supply plants is obtained, the expenditure on transmission and distribution may be three times as great as that on the

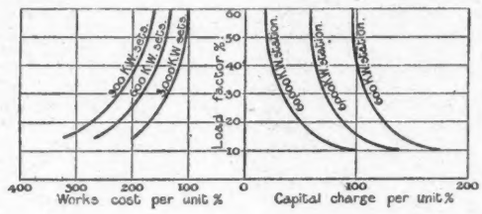

FIG. 1.

station, and the losses and costs of distribution may be increased by 100 per cent. Naturally these extreme figures are never reached in practice, therefore the margin in favour of the power company is a very considerable one.

It may be safely predicted that future developments will consist in the co-operation of electric supply undertakings with processes of manufacture in which fuel or heat is merely one of several products to be dealt with. The conditions of the electricity supply will no longer be the sole factor in determining the situation or magnitude of a generating station, but the economical handling of the other products of manufacture will also have a determining effect upon the decision.

There are a number of collieries in the West Riding where waste heat from coke ovens is available to an amount equivalent to, from 1,000 to 2,000 KW. To erect at each battery of ovens a generating station with spare plant sufficient to ensure a continuous supply in the event of breakdown, and to supply from such a station a fluctuating load such as a general power supply demands, is not an efficient arrangement. When, however, a number of such stations are worked in conjunction by a power company, the amount of spare plant may be reduced to a minimum, and each station would consist of a single generating unit, with no spare plant, running continuously at full load or else shut down completely. The resultant economy of capital expenditure and operating costs of such an arrangement is considerable. This is rather a reversal of the present idea of the peak load station, the author's view being that the station dealing with fluctuations would contain the biggest and most economical units, and would be the largest station of the system.

The development of electro-thermal and chemical processes introduces a class of load of high load factor, which, added to a general supply, increases the load factor on the system. But where, as is usual, the demand is a large one, the price at which it could be generated in a station designed specially for that purpose is so low, that only a large undertaking could offer a supply at a corresponding price. There is, however, a possibility of development in the use of a restricted supply of current varied according to the power station's requirements, and designed to equalise the demand on the station.

There is necessarily a considerable amount of generating plant which is lying idle for the greater part of the year; if a load can be found which may be varied inversely as the normal demand, then a profit may be earned by such machinery throughout the year. The author has recently arranged an agreement on these lines for the Yorkshire Electric Power Co. with a company manufacturing calcium carbide by electric furnaces. The improved conditions under which the station will operate should show a considerable decrease in the average costs of production.

The arrangements mentioned above involve co-operation between those who produce waste heat, the general power user and the power company, and, in fact, the power company may be regarded as a joint committee of such manufacturers. The co-operation of collieries alone through such an agency would effect an enormous annual saving. The output of coal for Yorkshire in 1906 was 33 million tons, and assuming, as we fairly may, that 5 per cent. of this was used for power purposes by various collieries, we have an amount of fuel which, if consumed by the power company under their economical conditions of working, would supply not only the collieries but practically all the textile mills in Yorkshire.

The blast furnaces of the kingdom also produce a large amount of waste heat, and a very large portion can be utilised by co-operation with the power companies.

The considerations dealt with above as to the advantages of a public supply to a power user apply with even greater force to small and medium-sized public supply generating stations, say, of

less than 10,000 KW. Co-operation between authorised undertakers seems to the author a vital necessity if progress is to be made. The older generating stations are situated in the centres of the towns they supply, and the developments in the economical generation outlined above cannot in such circumstances be taken full advantage of. Where distribution of electricity is considered, however, the local authorities controlling an electrical undertaking have more justification for dealing with the matter themselves. The joint control of a supply by a company and a corporation is an arrangement which the Board of Trade do not favour, and possibly it is one which would present many difficulties in working. It has occurred to the author that a way out of the difficulty might be found if the local authorities were empowered to become debenture holders in the company. They would thus exercise some control over the business if improperly managed, and the provision of further capital would depend on the satisfaction given by the company to the local authority.

Of causes other than the direct advantages of power supply, which are assisting the development, two may be mentioned. The abolition of the smoke nuisance in towns is receiving increased attention on all sides, and there are undoubtedly signs of decrease of the nuisance in towns due to the use of electric motors and gas stoves, as well as to the more stringent action taken by some local authorities. Doubtless the improvement in the atmosphere of districts where the electric supply is generally adopted will become so noticeable in a few years that other districts will be forced to take action. It is obvious, however, that strong action cannot be taken fairly by the local authority unless a cheap power supply is available in their district, and they must first see that such a supply is provided. But a more important reason for the action of local authorities in the matter of a cheap power supply is the steady industrial exodus that is going on from all the large towns. High rates, crowded sites, and dear power all act as an incitement to a manufacturer to remove to a cleaner and better place. The ultimate effect of this decentralisation on the finances of large towns is a matter worthy of the most serious consideration.

The fact has been impressed on the industry lately by the technical Press, and with considerable justice, that the selling organisation of most supply undertakings has been somewhat neglected. Here again, is room and a necessity for co-operation amongst the various supply authorities. Any one who, like the author, has had to do pioneer work in the electrification for the first time of an industry such as the textile, realises how valuable may be an accumulation of data relating to the power taken by various machines, the unit consumption, the load-factor, &c. If every undertaking were working together, such information could be collected by a central bureau and would be available to all. This refers not merely to technical data, but also to such points as legislative restriction and Government regulations. For example, we cannot hope to obtain a general improvement of the law with regard to easements for overhead lines until a strong case is made out by the collection of data from all parts of the country as to the present disadvantages suffered.

Of much greater value would be a central advertising association. One is only too apt to assume that the general public are familiar with all the advantages and developments of the use of electric power. It may be safely said that the general public, except perhaps as regards electric tramways, is more ignorant of the extent of electrical development (in which, in this country alone, over £340,000,000 of capital is employed) than of any other industry of similar importance.

This can only be removed by systematic advertising and circulation of information, and this, again, can only be properly carried out by a combination of supply authorities each contributing to a common fund for such work. A contribution of 1 per cent. of the revenue per annum would allow advertising to be carried out on a scale sufficient to give a big impetus to the business. On a small scale the various power companies are co-operating in this way through the medium of *Electrics*, and the London supply companies also have a joint publication; an advertising combination of every supply undertaking, municipal or company, would, however, be of enormously greater value.

DISCUSSION.

MR. S. D. SCHOFIELD said he agreed that Parliamentary privileges creating a monopoly had retarded the development of the industry, and there were very few towns in Yorkshire where this monopoly had not operated to the disadvantage of the whole district. Regarding the tendency of private users to produce misleading figures as to the cost per unit generated with their own plant, in one or two cases he had found that upwards of 50 per cent of the charges properly due to the private plant had been left out of the calculation altogether. Test figures which could be obtained on a full load test were very rarely obtained in a central station. It often occurred that they had a load that was too big for one and not large enough for two sets to be run on their most economical loads, the result being an increased steam consumption, which considerably discounted the figures shown in the paper. He thought that to induce a corporation to take debenture shares in a supply company would be a more difficult proposition than to induce two neighbouring corporations to have a joint central station for their own use. He agreed with the author that a central bureau should be established for retailing information which was collected from time to time. In twelve months one might have, perhaps, sent out three or four circulars asking for information, and received anything between 30 and 40 other circulars; each engineer got this information out for his own Council or company, and filed the matter away. If this information were filed at a central bureau it could easily be consulted by anybody in the industry, and it would be a great advantage and save considerable time of other engineers. With regard to the question of tariff, the crux of the whole matter was the rate per unit. He could name towns where rates had been quoted which in themselves were certain to result in a loss, and these rates were only possible because they were given at the expense of other classes of consumers.

MR. H. DICKINSON, referring to the table of costs per kilowatt, thought the figures which the author gave were rather low, and that £10 per KW. for the 60,000-KW. station should be increased. With regard to the diversity factor, Mr. Woodhouse seemed to be of the opinion that the diversity factor only operated in large stations, whereas it operated in a small station, but not to the same extent. He did not think the conclusion, therefore, that the capital cost was reduced in the ratio of 4 to 1 was correct. Many people forgot that the distribution system was very costly, and that a great deal of extra capacity of mains had to be provided over and above that actually required for the actual maximum load. The distribution costs were a more serious item than some engineers imagined. The author made too much of the view that the power company could supply cheaper than the private user could generate at, and did not lay enough stress upon the advantages to be gained by users in taking a supply from an outside source. The author mentioned that experience showed that the station demand would not exceed one-third of the total lighting connected to the system or one-half of the power installed by power users. He had some figures regarding the Leeds undertaking, and found that only half the lighting installed and one-third of the power installed was on at one time.

MR. F. M. MOODY said the cost per kilowatt of the power company must include all capital expended in supplying current to the consumer's switchboard; if this were done the total cost per kilowatt would be nearer £20 per KW. than £10 per KW. The cost of private plant was put too high; recent figures obtained for a 200-KW. plant worked out at £14 per KW. The use of gas and oil engines in these smaller units must be taken into consideration. In respect of load and diversity factor, the works plant was in a unique position, inasmuch as the plant installed could be suited exactly to the load which was ascertained before the plant was erected. The load factor in a works was always pretty high. No mill-owner dreamt of duplicating his steam plant, and for that matter no electrical engineer would favour duplicating the motors installed; that being so, the necessity of duplicating plant was not apparent. Considering the small works plant, which had no complicated system of mains, and had a high load factor, and could install the one-unit type of plant consisting of boiler, engine and generator, with the shortest steam main possible, he failed to see how the larger station could supply current as cheaply as it could be generated on the works. A point in favour of power company supply was the unlimited power at the command of the consumer, which was important in many cases. If current could be supplied from the power companies at ·5d. per unit, the small private plants would soon, from an economical point of view, cease to justify their existence, but such a time was scarcely with them yet.

MR. E. I. LOVE thought the cost per kilowatt, as mentioned, was about the correct figure, but he took exception to the figures given for coal in the table as not being consistent with actual practice. They would probably have a consumption of about 30 lb. of steam per kilowatt for a load factor of 20 per cent., and that was a fair average figure for a central station. With a load factor of 100 per cent. this would not be decreased much below 20 lb. per kilowatt, so that the difference in the coal bill with the three different load factors would not be anything like as great as that stated. Quite recently they had had an offer from a consumer to take 150 KW. He had been using a suction gas plant, but wanted to take it out and so get rid of the bother and expense of breakdowns, &c. He would be quite satisfied with the supply at ¾d. per unit.

MR. W. B. WOODHOUSE, in reply, said it was very difficult to make out a table of costs to meet everybody's views. Any argument that applied to the use of gas engines for one station seemed to apply equally well to the others. The capital cost per kilowatt came down in much the same proportion, but he did not think the fuel economy went up to the same extent. Some companies who had Power Acts had never put them into force, simply because of the protective clauses obtained by local authorities. It had been waste of money to get the Acts, for they had been protected out of existence. The steam consumption figures were test figures, and the coal figures ought to be got on test with almost any respectable coal. The Yorks Power Co.'s present load-factor was 45 per cent. The Newcastle Co.'s load factor, he thought, was 60 per cent. or very near it. He expected to get a load factor approaching 80 per cent., so that it would not be difficult to get the 60 per cent. mentioned in the paper. Power users did not come on as rapidly as they ought to; they got let in with suction gas plant and all kinds of novelties, and he thought there was no doubt that the company would not get the full benefit until they had a very big proportion of power users taking the public supply; they would have to get the first 50 per cent. on to the mains without utilising the advantages mentioned in getting a higher price, and the other 50 per cent. would, no doubt, follow in due course. He had talked with a number of colliery owners and found an increasing tendency towards co-operation. The ideal thing from the power station point of view was to get the colliery people to co-operate and make their coke at one central station. It would probably pay to carry the coal within a radius of three miles to the ovens, and they might then get coal from three or four pits. In Durham a joint scheme was in operation, being run by the Durham Power Co. His definition of load factor was the ratio of units generated to the units that would be generated if the plant was running at the maximum load; not the maximum kilowatts in the station, but the maximum load recorded in the period.

Automatic Cab-Signalling on Locomotives.

By J. Pigg, Member.

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(*Concluded from Vol.* 61, *page* 1046.)

The system lends itself readily to the adoption of means by which the "condition of line" signals obtained may be easily recorded for each signalling point. The length of time during which the semaphore arm is maintained at "danger" differs in accordance with the condition of the line. If an "off" signal is obtained at B the time is short; if the "on" signal is received the time will be longer, and will depend upon the point at which the "off" signal is ultimately received. In any case the difference is appreciable. This difference may be utilised in order to produce marks of corresponding length upon a cylinder which rotates and travels longitudinally at the same time, by adding a marking pen or pencil to the rod *b* of A^1, so that a mark is made as long as the armature (*a*) is raised. The motion of the cylinder causes the marks to form a spiral. For places where the "off" signal is obtained at the bar B, the mark is a dot only. Where the "on" signal is obtained at B, the mark is a line of greater or less length according to the time that elapses before the "off" signal is obtained. The drum carrying the paper cylinder is driven by clockwork, and is under the control of the signalling apparatus, so that it is only running when marks are to be made, and the driving mechanism and the marking cylinder are therefore kept of quite moderate dimensions. Arrangements are made by which the driver can produce a space longer than that provided by the design of the apparatus, and so distinguish between the marks made during one journey and the next.

A careful consideration of the description will show how fully the apparatus meets the conditions found necessary or desirable in the introductory examination of the requirements.

1. (*a*) The natural action of the bar A, through the brushes, and that of the yielding bars upon the rotary switches upon the engine circuits constitute a signal, warning the driver of his approach to a signalling point, at which further indications must be looked for *at once*. (*b*) Neither the engine driver nor the signalman is required to do anything to produce this signal. (*c*) The indications being given from three independent points for double lines, and from two for single lines, provide ample margins for failures of apparatus from any cause outside ordinary maintenance of the battery. (*d*) The alternative methods for producing this indication, and the difference in their positions on the engine and track, are guarantees that anything likely to affect one means prejudicially is not likely to affect the other.

2. The continuance of the "warning" signal constitutes an effective "danger" "condition of line" signal, relating to the "stop" signals which are being approached. The bar A is situated at a distance of about 100 yards from B. The "warning" signal proper is therefore of short continuance only if the "stop" signals are "off." No time is lost in conveying the further indication "on" when the "stop" signals are in that position. The subsidiary indications, giving by the momentary stoppages of the bell, are valuable for indicating the progress of the train towards the "stop" signal, when conditions of weather prevent the ordinary landmarks from being seen.

3. The stopping of the "warning" signal by the return of the semaphore arm to the "off" position, the stopping of the bell, and the receipt of the "route" indication constitute a complete "off" or "line clear" signal, which, since it cannot be given unless both the "stop" signals controlling entrance to the next section are "off," gives also the exact information now given by the lowering of the line distant signal. The convention under which the "route" indications are numbered is in strict accordance with the convention under which the line signals are erected. The left-hand signals refer to the left-hand road, and so on, for any number of diverging roads. The numbering of the "route" indicators is from left to right, as will be seen by reference to fig. 1. A straight-through point is always signalled as 1.

4. Either "condition of line" indication received at bar B can be reversed before the engine reaches the "stop" signal. That is to say, an emergency "danger" signal can be given at any one of several intermediate points if the "off" signal has been obtained; or an "off" signal can be received at the same intermediate points if the "on" signal was originally obtained at B. The number of intermediate points at which these reversals can be obtained is limited only by the number of intermediate bars provided. Additional bars are not costly, as will be obvious from the illustrations.

5. The "off" signal can be given when the train is standing at the "home" signal equally as well as when it is travelling, and attention is called to its being given by the audible signal. The signal given when the train is standing at the "home" signal can be modified by the signalman to indicate a "calling on" signal, or the equivalent of a flag signal, and this is totally distinct to the "off" or "line clear" signal referred to already in this section.

6. Indications are provided in the cabin by which the signalman knows whether his apparatus is in order, and by which he can, if he desires, trace the progress of a train towards the "home" signal from the bar B, and note whether the signals appear to be given correctly.

7. The system, being electrical, admits of the signalling point—the bar B—being put at any distance from the cabin without affecting the efficiency. There is, therefore, no reason why it should be put at the point at which the line "distant" is now erected. Such signals are usually visible at some distance, and there is no reason why the bar B should not be set at this "sighting" distance. The increasing speed of trains makes it desirable that the signals given at B should be obtained as early as possible, to admit of easy braking when necessary.

8. The line distant signal plays no part in the working of the system, and may be dispensed with if desired.

9. A further examination of the system will show that failure of the apparatus on the line will not cause a false "off" signal to be given. Any failure of the battery in the cabin, or breakage of the line wire, puts the bars B, C, D and E into exactly the same condition as A, which can only produce the "danger" indications. Contact of the line wire with telegraph wires on the same poles is not likely to give a false signal, as the apparatus on the engine requires stronger currents than are to be met with in telegraphy. Failure of the apparatus on the engine provides its own indications. These have already been mentioned.

10. Probably the most important requirement from such a system is that of reliability. No matter what other advantages a system may possess, a want of reliability will be fatal. The most important point in any system is the means by which the signals are collected. Theoretically, the maintenance of such means of collection should be a matter of difficulty during bad weather, as snow or ice is liable to form an insulating layer upon the top of the line bars, and thus prevent the collection of the currents. As has been said, this is a theoretical consideration, and, necessarily, owing to the absence of bars for such purposes in this country to such an extent as to allow of the forming of a definite judgment, there is little or no local evidence for or against. The experimental work in connection with this system, however, has extended over the last two winters, and no difficulty has been experienced in collecting the currents owing to the presence of snow or ice. The surface of the bars is slightly rounded to allow water to run off, and only a thin film of ice can form. The contact between the brushes and the bars is of a particularly searching character, due to the construction of the former. They seem to clean the bars effectually at every operation, and if more engines were equipped, this question would hardly appear at all. In any case, occasional rubbing of the surfaces of the bars with an oiled rag, which can easily be done by the platelayers when making their daily inspection, seems to prevent the formation of continuous films of ice throughout the lengths of the bars. This matter is largely a question of adequate maintenance, obtained by co-operation with other departments. Like all engineering work, cab-signalling apparatus requires attention. Such attention is always better directed towards the prevention of failures than to repairs after failures have taken place. Intelligent maintenance is all that is required.

During the two years' experimental work, it has been found that the maintenance of the insulation of the energised bars, B, C, D and E, is of much greater importance than the contact between the bars and the brushes. The first energised bars were insulated in the same manner as the bar A, and worked perfectly well in good weather. Long-continued rain was, however, found to soak the sleepers and wood blocks supporting the bar to such an extent as practically to short-circuit the battery. Since the double-shed insulator has been adopted, nearly 18 months ago, no trouble in this respect has been experienced, and the insulators have given no trouble from breakage, except when they have been used as targets by mischievous boys.

The question of the reliability of the system is bound up in the maintenance of good insulation and perfect contact, since, although failure to collect the currents results in the maintenance of the "danger" indications, and is, therefore, on the side of safety, the "off" signal is of almost as much importance as the "on" signal, from the point of view of dispatch of traffic, and railway companies could not countenance any apparatus the working of which unduly delayed their traffic.

On the reliability of the systems depends the important question of whether railway companies will obtain any of the financial relief which, as already stated, is most desirable. The design of the apparatus is such as to render unnecessary the whole of the complex and dangerous arrangement of fog signalling by explosive detonators now universally used by railways at great expense.

11. Further consideration will show that this system is capable of being adapted to use of parts, instead of the complete system as herein described, on less fully developed railways where the conditions of service are not so onerous. It is capable of being adapted to show signals for "distant" and "home" signals, or as already stated, it can be adapted to operate with the present "distant" signal only. As described, however, the arrangements are such as to give the maximum information with a minimum of apparatus, and, moreover, it provides further inducement in that, as the line distant signal is superfluous, it may be dispensed with. It is essentially a contact system in which shocks due to impact have been practically eliminated without impairing its reliability. It is, however, capable of being operated as a "contactless" system, with all operations for giving signals on the engine carried out under magnetic influence.

12. The system has now been in use experimentally on the North-Eastern Railway for nearly two years, on what is the fastest short-distance train in the world, and on other express passenger trains. No attempt has been made to develop it by trials on slow trains. Under the conditions of use, the apparatus is working perfectly. The directors of the North-Eastern Co. have arranged for the equipment of 20 more of their express engines and of about 14 miles of their main line between Newcastle and Durham.

Dry cells have been found to give the best results on the engine, and have given perfectly good results in connection with the track-circuits.

The (London) discussion was opened by MR. J. W. JACOMB HOOD (L. & S.W.R.), who said that in his opinion railways would have to depend on some system which would provide communication between signalman and engine. This, however, was only a supplementary system to the ordinary signals, and it was questionable whether a supplemental system was wanted. It also did not remove the possibility of disregard of signals, which he considered had principally contributed to past accidents. He believed that the railways would move in the direction of taking the control from the driver.

MR. A. C. BROWN commented on the fitness of the wire brush contacts employed in the system described, but he was surprised that the supplementary disk contact should have been introduced, as a flexible contact was better.

MR. A. T. BLACKHALL (G.W.R.) said that he considered it necessary in such a system, that the signal should go to danger if anything went wrong—that is, the danger signal should be obtained by breaking and not making an electrical circuit. This his company had arranged on the experimental system on the Fairford branch, where they had dispensed with distant signals and used cab signals in conjunction with a whistle for "danger" and bell for "all right." He thought there might be a danger if all the electrical apparatus broke down, of the driver getting no warning and running on to his home signal before he knew it.

MR. R. BURN remarked that the system was exceedingly complicated, and, therefore, costly. He considered that if a cab system were adopted, it should supersede outside signal posts, but in any case a difficulty arose in regard to foreign engines working over the route. It was most necessary to keep down expenses, and this required that the signal should be off the cab, even if the bell or whistle were on it to show where the signal was.

MR. ALEX. SIEMENS agreed that the cost was a most important thing, and that the arrangement shown appeared somewhat complicated; even the much simpler Fairford arrangement had been criticised as costly. A fatal defect appeared to be that the danger signal was obtained by making and not breaking the electrical circuit; he also thought that the B. of T. insisted on different audible signals for danger and safety.

MR. ANDERSON considered that the apparatus did not comply with two important requirements—that the danger signal should be produced by mechanical means, and that the danger and safety signals should be obtained, by separate means. It also appeared that while the track signals stood at normal "danger" the cab signals were at normal "all right." When going from double line to single line the driver had to reverse a switch, which imposed an additional strain on his memory, and there appeared to be several other defects, in his opinion.

MR. H. J. JEFCOATE, who referred to the complicated nature of the apparatus, also mentioned a system designed by himself, which has received a trial on the North Staffordshire Railway, and was described and illustrated in our last issue.

MR. RAYNER WILSON pointed out that the author had mentioned the possibility of dispensing with distant signals with the system described. He considered that the large number of track contact bars was a good feature, as giving a continuous indication to the driver, but it appeared that the bell would continue to ring even should the signal go from "on" to "off" in the interval, and this might escape the notice of the driver.

MR. J. PIGG, who decided to reply in writing, said that no trouble had been found with the rotary auxiliary switch, which was used in case the main brushes were carried away. He pointed out that the system described provided route indicators, which was not the case with the system tried on the G.W. Railway, and that the cab signal was arranged to show the indication of the last signalling point, and hence was normally in the "all right" position; further, in case the apparatus failed, the indicator stood at zero, and not as assumed by various speakers.

Written communications were received from MR. J. A. F. ASPINALL (L. & Y. Railway), who referred to somewhat similar apparatus tried on the Northern Railway of France in 1877; and from MR. F. W. COOKE (G.N. Railway), who commended the system described, and added his opinion that expense was not such an important object in the experimental stages.

He further suggested that an insulated section of the running rail might be employed for energising the apparatus instead of contact bars.

MR. JAMES BOWMAN also wrote pointing out that, with the arrangement shown, a driver might possibly pass the distant signal at danger, there being no warning that he had done so, and then mistake his home for his distant signal and overrun it. It was very necessary to have a warning at the distant signal. The cost appeared to be the prime objection to automatic cab signalling, and but for that, it would be better to provide for continuous communication between driver and signalman, thus ensuring against emergencies.

Notes on the Proposed Home Office Regulations.

By FRANK BROADBENT, M.I.E.E.

(Abstract of paper read before the ELECTRICAL CONTRACTORS' ASSOCIATION (INCORPORATED), *December 18th, 1907.)*

THE author gave it as his opinion that existing wiring rules which no one had the authority or the right to enforce, acted as a handicap to reputable firms, who generally estimated for work which would comply therewith as far as possible, whilst unscrupulous tenderers, by taking advantage of the knowledge that the rules were merely suggestions, and not a mandatory code, could cut prices and also the quality of the work. He was of opinion therefore, that it would be to the general advantage of the industry if a code of rules could be adopted which could be made compulsory under penalty for non-compliance. The two principal difficulties in drawing up such a code of rules were that if of too general a nature too much power was left in the hands of local inspectors to decide what should and should not be approved. On the other hand, if the rules were too detailed there was a tendency on the part of manufacturers or contractors to work to the strict letter rather than to the spirit of the rules, arguing that anything not specifically mentioned was not intended to be covered by them.

Mr. Broadbent then dealt *seriatim* with the proposed regulations, detailing also the objections which had been raised thereto by the I.M.E.A., by the Society of Power Companies' Officials, by the Associated Municipal Engineers (Greater London), and by the Electrical Section of the London Chamber of Commerce. A common objection raised by most of these bodies was as to the general nature of the rules, and also as to the restrictive tendency of some of them. It was contended that the rules relating to cables were more restrictive than the Home Office Mining Regulations, tending to give the impression that workshops and factories were more dangerous than mines for electrical applications. The author read the proposed factory regulation, and compared it with the mining regulations, contending that the latter and not the former were the more restrictive and comprehensive.

Touching upon the regulation relating to switches and fuses, to which so much exception had been taken, the I.M.E.A. even claiming that there must always be a certain risk in handling fuses, Mr. Broadbent pointed out that what appeared to be aimed at by the rule was not necessarily the provision of a separate switch to every fuse, but that there should be the power of making a fuse-way dead in order to replace the fuse wire. This condition was met by the provision of a D.P. switch to each distribution box. An alternative was provided—namely, to make the switch of such a type that no shock or burn could be obtained in handling it. The author pointed out that many fuses advertised as being in conformity with the Home Office requirements were not really so. Such advertised fuses were of the well-known porcelain tubular handle pattern, with exposed live ends. Such a pattern certainly did not meet the conditions of the Home Office proposed Regulations, as there was a natural tendency for the operator to place his thumb on the live end whilst his fingers were grasping the porcelain handle. Either wide porcelain flanges must be provided at the ends of the tube or the live ends must be entirely covered. The type of fuse which was really called for if the conditions were to be met without providing a separate switch for each, was that known as the switch-handle pattern, in which the fuse and its contacts were all fixed below a screened insulating handle. Such switches were now readily obtainable in all sizes. The regulation which the author considered would be the one most strenuously objected to, and the one which if enforced would cause considerable expenditure on the part of owners in altering existing work, was that relating to motor-starting switches. This had been generally objected to by the authorities named, and was claimed to be quite unworkable, prohibitive, unnecessary and to involve expense far outweighing any advantages which would accrue. This regulation called for the provision for each motor above ½ H.P. in size of a starting switch provided with a no-voltage release, unless the arrangements were such that the motor could not start on the supply being restored after a failure of supply. The chief objections to this rule were that to insist on this provision on motors of such small horse-powers as those above ½ H.P., meant unnecessary expense which would tend to restrict the use of small motors, and further, that the regulation should not apply to polyphase work.

Mr. Broadbent pointed out that even were such objections sound ones, they applied equally to the Institution rules, which were drawn up by a committee composed very largely of municipal and consulting engineers, and engineers of electrical power distribution companies and public supply companies, the very men who were now objecting to the enforcement of the rule by the Home Office. It was interesting to note that the following gentlemen who either were, or had been, chief engineers of public supply stations, formed members of the Institution Wiring Committee:—Messrs. C. P. Sparks, W. A. Chamen, W. H. Patchell, R. A. Chattock, J. E. Edgcome, J. Christie, F. E. Gripper and C. H. Wordingham. On the face of it, therefore, it would appear that these gentlemen, whilst desiring to force the rules upon contractors or manufacturers, very strongly objected to their being enforced against themselves by the Home Office.

In the discussion which followed the reading of the Paper, the general feeling of the meeting appeared to be in sympathy with the author's views, that if they were to have rules it were better that they should be capable of enforcement. The chief objections taken were against the general nature of the rules and of the definitions. It was thought that the definition "authorised person" was not sufficiently explicit, this definition being "a person appointed by the occupier to carry out certain duties incidental to the generation, transformation, distribution or use of electrical energy, and competent to carry out those duties." Rule 29 reads:—"No person except an authorised person, or person acting under his immediate supervision, shall undertake any work where technical knowledge or experience is required in order to avoid danger." It was felt that there was nothing to prevent an occupier authorising, say, an office boy to carry out technical work, and the regulations would be strictly complied with. There was an opinion expressed that

some means of registration or licensing would be of distinct advantage, and then the definition might be altered to make "authorised person" synonymous with "registered electrician."

ELECTRICAL EXHIBITS AT THE PARIS MOTOR-CAR SHOW.

THE annual Motor-Car Exhibition in the Grand Palais, Paris, which closed its doors on December 1st, was the tenth of the series, and in order duly to celebrate the "decennial" *Salon*, a much more elaborate scheme of illumination than hitherto attempted—although this has always been a feature of the great international display—was carried through. It is, indeed, difficult to convey by mere words even a faint idea of the enormous scale on which the lighting, not only of the interior and exterior of the magnificent

FIG. 1.—ELECTROS-CARDINET CAB.

building itself, but around the Place de la Concorde, and along the Avenue de Champs Elysées, the Avenue Nicholas, and the Pont Alexandre, was carried out. Along these thoroughfares, garlands of electric lamps had been erected, the scene at night time being unusually brilliant. Not only were thousands of coloured incandescent lamps pressed into service, but also large numbers of arc lamps, Cooper-Hewitt mercury lamps and search lights. As may be easily understood, this "orgy of light," as it has been described, necessitated considerable work on the part of the electrical engineers. No fewer than 80,000 incandescent lamps were used to light the nave and huge dome of the main exhibition building, while, on the Avenue Nicholas, 20,000 lamps were distributed, on the Avenue des Champs Elysées 12,000, on the Place de la Concorde 10,000, on the Esplanade des Invalides 10,000; 200 arc lamps were used in the Annexe, as well as 150 on the river bank. In addition, 250 Cooper-Hewitt lamps were employed, while it is estimated that for the lighting of the exhibitors' stands no less than 120,000 incandescent lamps were pressed into service. In the basement of the Grand Palais a temporary central station had been installed, this comprising 10 25-H.P. gas engines and dynamos, which furnished current only for the arc and Cooper-Hewitt lamps. The power station of the Metropolitan Underground Railway supplied 3,000 KW., the Lacarrière central station 150 KW., and the Champs Elysées district station 300 KW., all for the Grand Palais alone. In addition 300 KW. were supplied for the lighting in the Avenue des Champs Elysées, 200 KW. for that in the Place de la Concorde, and 1,000 KW. for the Pont Alexandre and the Esplanade des Invalides, where was situated the Annexe in which the industrial vehicles and the machinery in motion were displayed. The lamps were lighted for an average of three hours per night, the cost per evening being estimated to work out at no less than £4,000. Truly, Paris during the last three weeks of November was *une ville de lumière!*

Leaving the lighting of the *Salon* and coming to the exhibits, a walk round the never-ending galleries was an education as to the important industry which has sprung up to supply the electrical requirements of modern motor-cars. The ignition of the explosive charge in petrol motors has since about 1898 being effected electrically—at first by means of accumulators and induction coils, and later by magnetos of both the high and low-tension types—and the variety of exhibits of all these accessories was almost as great as the makes of motor-cars on view. The increasing popularity of covered motor vehicles, too, has brought with it a demand for improved means of lighting which is being supplied by electric lamp manufacturers, while in many other directions the development of the automobile movement has been of benefit to the electrical industry.

Passing now to the exhibits of motor vehicles, it may be said at once that by far the majority were of the petrol type, a noteworthy point being the entire absence in the pleasure car section of steam-driven machines; several firms who exhibited the latter at previous shows have abandoned them in favour of those with internal combustion engines. Thus it was left for builders of electrical cars to show that the petrol vehicle, notwithstanding the great progress that this has made in the way of quiet and easy operation, does not yet reign supreme. And in this connection we were glad to note that there is still quite a number of firms in France devoting attention to this class of machine; not only so, but a noticeable feature of the show was the marked increase in the number of cars on view of the combination petrol-electric type, in which the best points of both systems are embodied. In these machines the power developed by the petrol engine is transmitted to the road wheels by electrical in place of mechanical means, a dynamo and one or two electrical motors taking the place of the somewhat complicated system of transmission—clutch, change-speed gear and side chains, or cardan shaft and bevel gear, according to the method adopted—in the purely petrol car. As it will no doubt be of general interest, we propose briefly to describe some of the electric and petrol-electric cars that are not already known on this side of the Channel.

The Electros-Cardinet.—One of the principal features of the electric carriages (figs. 1 and 2) built by La Compagnie Française de Voitures Electromobiles, of Rue Cardinet (Parc Monceau), Paris, lies in the disposition of the different parts of the mechanism, the motor A being situated in the fore part of the frame, with its spindle at right angles to the road wheels and driving through a silent chain A a long shaft C provided with cardan or universal joints, the final transmission to the rear live axle being through enclosed bevel gear D. Three types of chassis are made, ranging in price from £360 to £440, while the cost of the battery varies from £100 to £120, and that of the carriage body from £192 upwards, the minimum outlay for a complete vehicle being thus £652. In running order the passenger vehicles for town use weigh 1,750 kg., or 34 cwt., made up as follows:—Chassis, 12½ cwt.; accumulator, 12½ cwt.; and carriage body, 9 cwt. In addition to town carriages—coupés, landaulets, &c.—the company are also devoting attention to electrical vehicles for industrial purposes, including 20 and 30-cwt. vans and lorries, and public service char-a-bancs having accommodation for 15 passengers.

The company have not informed us as to the type of battery they employ, but state that its capacity is sufficient to run the vehicles a distance, under ordinary conditions, of 100 kilometres (62½ miles) on one charge. The accumulator is divided into two groups, one situated in a receptacle formed at the rear of the body and the other at the front. The load on the wheels is thus fairly well balanced, that on the front pair being 16½ cwt. and on the rear wheels 17½ cwt. Owing to the motor being mounted higher in the frame than is usual, it has been found unnecessary to build it of the ironclad type, so that the working parts can all be readily inspected. It is of the four-pole series-excited type, with a double winding on the armature, the pole windings being in series, two by two.

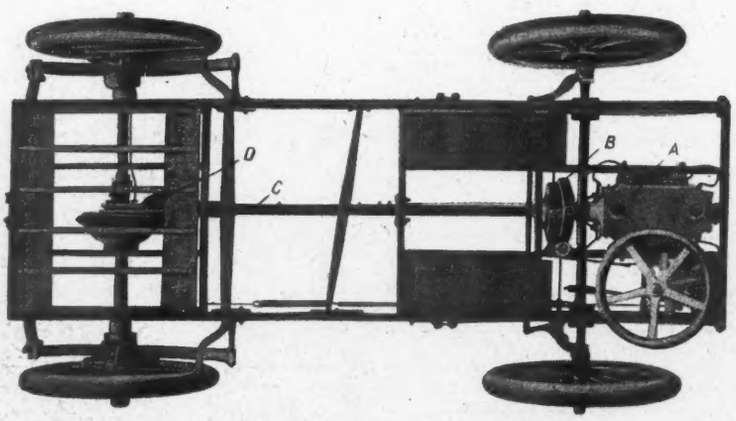


FIG. 2.—CHASSIS OF ELECTROS-CARDINET VEHICLE.

A special feature of the system is that the different speeds are obtained entirely by varying the coupling of the armature and field windings of the motor, the cells of the battery being permanently coupled up in series. Thus the first speed, 4 to 5 M.P.H., is obtained when the two armature windings are in series with the two field windings and a starting resistance. All the windings in series without resistance, gives the second speed—6 to 7½ M.P.H.; for the third speed, 9 to 11¼ M.P.H., the two armature windings are arranged in parallel and placed in series with the two field windings, the latter being in series. The fourth speed, 13½ to 15½ M.P.H., is got by placing the field windings also in parallel.

An electric brake is provided, with a rheostat in series, and the reverse motion is similar to the first forward speed, but with the current through the armature windings reversed. The controller is

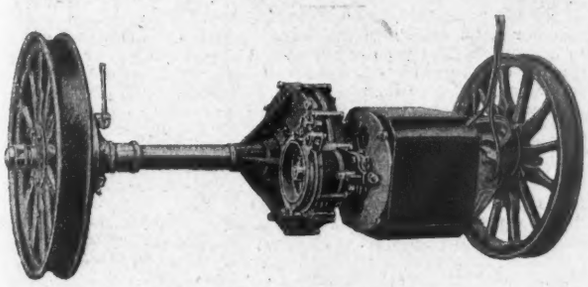


Fig. 3.—Rear Axle of Dinin Car.

operated by a pedal within convenient reach of the driver. In addition to the electric brake, two mechanical ones, both controlled by pedals, are provided, one acting on drums attached to the hubs of the rear wheels and the other on the intermediary shaft. The application of either brake also automatically cuts off the supply of electrical energy to the motor.

The Dinin Electrical Carriages.—A very interesting series of electrical carriages is being built by M. Alfred Dinin, of Quai National, Puteaux (Seine), France. In outward appearance the Dinin vehicles (figs. 3 to 6) closely follow the lines adopted in modern petrol cars, while in the construction many of the features of the latter, such as pressed steel frames, inclined and irreversible wheel steering, and ball bearings to all parts, including the electric motor, have been adopted. The whole of the mechanism, including the electric measuring and controlling instruments, the brake gear, and the cables—which are kept as short as possible—connecting the battery through the controller with the motor, are all mounted on the chassis, enabling any form of body to be fitted to the latter, so that by the removal of four bolts only it can be readily detached and interchanged with another. Three models are being made, of respectively 5 h.p., 7-8 h.p. and 10-12 h.p., the first being designed for two and three-seated bodies, and for average speeds up to 15 m.p.h ; the second for three

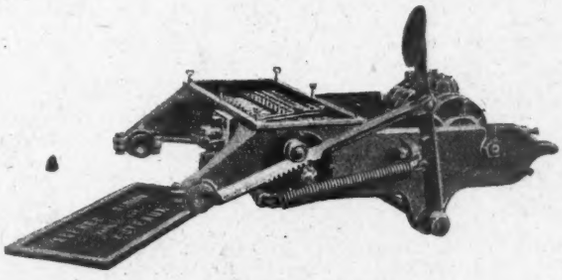


Fig. 5.—Dinin Pedal Controller.

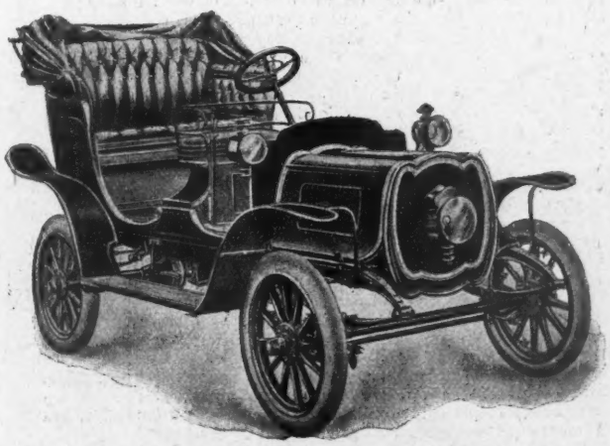


Fig. 6.—Dinin Electric Victoria.

and four seated carriages and an average speed of 14 m.p.h., and the third for large covered bodies seating four or more persons and capable of maintaining an average of 22 m.p.h. The price of the 10-12-h.p. chassis is £636, or complete with a highly-finished limousine landaulet body, £800. In the smaller models the side members of the pressed steel frame are quite straight, while in the larger types they are narrowed at the front in order to increase the lock of the steering wheels.

The battery, which consists of 42 cells of the firm's own traction type adapted to be charged off 110-volt circuits, is divided into two groups—one being situated in a receptacle in the carriage body, and the other under a bonnet in front, resembling that which covers the engine in petrol cars. This arrangement has been adopted, not merely with the object of producing a carriage which shall have more the appearance of an automobile than that of a horse-drawn vehicle, but mainly because of the better disposition of the weight on the chassis, springs, axles and tires, that it renders possible. In the Dinin vehicles only a single electric motor is employed, this being supported either from the rear axle or directly from the frame, according to the type of car, the transmission being by spur gearing. The motor is of the semi-enclosed armoured four-pole type designed to furnish for short periods, as when climbing hills, double its rated power, without overheating.

The control is by a single pedal, by the operation of which the car can be started and stopped without jerking, and the full range of forward and reverse speeds, as well as the braking by the motor, obtained. The driver thus has his hands left free for the control of the steering wheel. The different speeds are obtained by

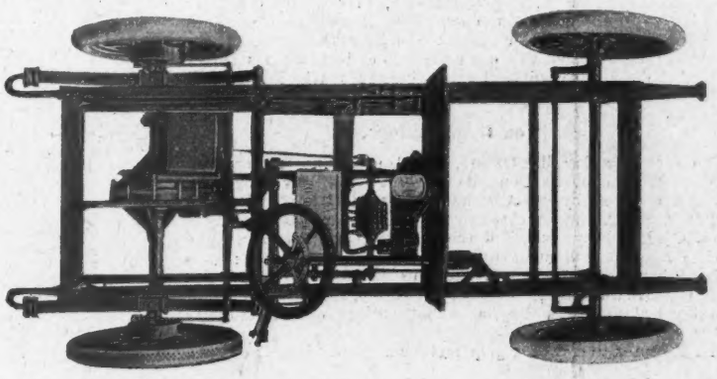


Fig. 4.—Plan of Chassis of Dinin Electric Car.

coupling the cells in series or in parallel, combined with variations in the magnetic field of the motor. The controller, which is situated under the driver's foot-board, comprises two cylinders—one for the different speeds and one for reversing the direction of running—enclosed in an aluminium case. The speed cylinder is rotated by the pedal, through a rack and pinion gear, while the reverse motion cylinder is controlled by a lever on the steering-wheel, and is so arranged that it can only be operated when the speed cylinder is at neutral—that is, at the position when the current is cut off. The control pedal when fully depressed operates expanded brakes within drums attached to the hubs or the rear load wheels, while a hand lever actuates an emergency brake on a drum on the motor spindle. A small pedal is also provided to cut off the current instantly and so quickly bring the vehicle to a stand in case of emergency.

(*To be continued.*)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Ferranti A.C. Time-Limit Relays.

The question of time-limit *versus* instantaneous action of circuit-breakers is one to which great attention has been given both in this country and abroad. At the present moment it may be said that the best practice calls for time-limit circuit-breakers on all feeders on high-tension alternating-current systems. The installation of such circuit-breakers has become standard practice in America, and is generally adopted in this country. Generally speaking, the time-limit element is provided by means of an auxiliary relay, as it is not found possible to have an apparatus other than a relay which will allow both the time required to operate, and the current at which operation takes place, to be adjusted independently. The general practice is to arrange the main circuit-breakers to be tripped by means of a continuous-current trip coil. In many places, however—as, for example, in sub-stations—continuous current may not be available. The installation of a special battery for working the trip coil is open to objection. Messrs. Ferranti, Ltd., whose alternating-current control relays are now well known in most parts of the world, have lately got out a series of alternating-current maximum time-limit relays, arranged so that continuous current is not necessary

for operating the trip coil. We illustrate, fig. 1, such a relay made by Messrs. Ferranti, Ltd. The relay normally short-circuits the trip coil, which is wound for alternating current. So soon, however, as the overload is continued for the predetermined time element, this short circuit is removed, and the current from the secondary of the current transformer flows through the

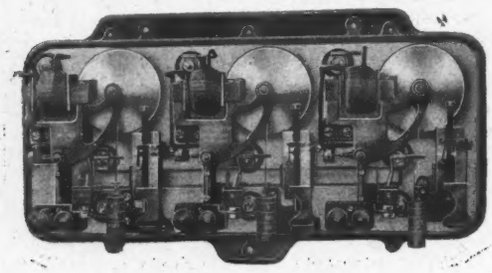


Fig. 1.—Ferranti A.C. Time-Limit Relay.

trip coil, operating the switch. These time-limit relays are arranged single, double, and triple pole, in ordinary cases for screwing to the front of the switchboard, and also in flush type cases. It might be mentioned that instantaneous relays can also be supplied arranged to open the trip-coil circuit instead of closing the same, so that alternating-current tripping can be arranged for in place of direct-current tripping.

Witton Grip Fittings.

The accompanying illustration, fig. 2, shows the new patent continuity device for steel conduits which, as we recently mentioned, has been acquired by the Armorduct Manufacturing Co., Ltd., of Farringdon Avenue, E.C. The subject of metallic continuity is one which has always exercised the minds of inventors, and many devices have been brought forward, of varying efficiency; it is claimed, however, that the one before us possesses qualities which place it above all others, as regards simplicity, reliability and cost. The illustration shows that a conduit fitting of the ordinary unscrewed type, and of the size ordinarily used, is slotted over part of its diameter, and a claw grip metal clamp, which is fitted with

Fig. 2.—Armorduct Co.'s New Grip Fitting.

keen projections or teeth, when the binding screw is tightened home, firmly engages the tube; in the closing and scraping movement which naturally results, the enamel, which would otherwise prevent electrical continuity, is automatically removed. A mechanical contact of great strength is secured, accompanied by electrical continuity. The device can be applied to all ordinary fittings. Tests carried out at Faraday House show that the resistance of five short lengths of enamelled steel tube, connected together by two T-pieces and two elbows, which were fitted with the Witton grip, was 0·04 ohm, when 12 amperes was passing; the tube was 6 ft. 9 in. in length, and ⅝ in. in diameter. A force of 130 lb. failed to loosen the grip on a tube of the same size, and the grip was also found to offer a great resistance to torsion. The report states that the grip is shown by the tests to be a simple and effective method of obtaining electrical continuity in a conduit system, and that the enamel is removed in the act of tightening up the joint, while a sound mechanical joint is secured.

Electric Plant Culture.—The electric culture installation lately set up in the gardens of the Royal Botanic Society in Regent's Park by Mr. B. H. Thwaite has been working provisionally for some weeks. A committee has now been formed to take charge of the experiments, and a control house has been arranged, where plants will be grown for comparison under precisely the same conditions, but without electric light.—*The Times.*

PARLIAMENTARY.

Tramways from London to Windsor.—By the London and Windsor Motor Roads, Tramroads and Tramways Bill it is proposed to construct a road from Hammersmith Broadway to Windsor, for the use only of mechanically-propelled vehicles, and to also lay a tramway along the road, which shall, where convenient, be joined up with other systems. The capital of the company is £1,215,000. 12 acres of land at Isleworth is scheduled for a generating station, and power is taken to manufacture and sell electric energy as well as petrol, gasolene, &c. For the purchase of the tramways by local authorities the period of 42 years is substituted for 21, and the terms on which the company shall be required to sell are those of paying the fair market value as a going concern without any allowance for compulsory purchase.

Dublin and Central Ireland Power Scheme.—Under the Dublin and Central Ireland Electric Power Scheme authority is being sought to incorporate a company with a capital of £450,000, to establish generating stations and to supply electric energy to authorised undertakers, and those requiring energy for power purposes only in the counties of Dublin, Kildare, King's County and Queen's County. The company is not, however, to exercise any of its powers in the City of Dublin without the consent of the Dublin Corporation.

Morecambe Tramways.—A Bill has been deposited in Parliament by the Morecambe Corporation to carry into effect the agreement arrived at for the sale of two tramways in the borough belonging to the Morecambe Tramways Co. The tramways are at present worked by animal traction, and the Corporation proposed to borrow £44,327 for the reconstruction for electric traction and the purchase of rolling stock and £10,000 for electrical feeder cables, &c. The purchase price is to be fixed by agreement, or, failing that, by arbitration.

RECENT EXHIBITIONS.

Physical Society of London.

(*Concluded from Vol.* 61, *page* 1050.)

Messrs. Nalder Bros. & Thompson, Ltd., exhibited various portable instruments and testing sets, including the "Ohmer" and their automatic accumulator switch. They also showed their indicating wattmeter, which is provided with iron cores, so that powerful working forces are obtained, while avoiding errors due to hysteresis, &c. The moving coil has very low self-inductance, and moves in a strong magnetic field produced by the series winding. The instrument can be enclosed in an iron case without affecting the readings.

Mr. A. C. Cossor exhibited Phillip's electroscope, an instrument specially designed for work with radio-active bodies, which can be introduced into the interior by means of a door, while the top is of aluminium, to admit radiations. Other materials can readily be substituted for aluminium. The gold leaf, which is apt to have ragged edges, and is an extremely difficult thing to handle, is replaced by a fibre of conducting glass, which is also lighter than gold leaf, and can be read with great accuracy. The fibre and its support are insulated with sulphur and are charged by means of a movable insulated rod, which can be drawn back and earthed. A new charging rod, also designed by Mr. C. E. S. Phillip, was shown; this consisted of a central celluloid rod charged by friction with a spring, these parts being enclosed in an outer case. Both positive and negative charges can be obtained of varying strengths, and practically without regard to atmospheric conditions. A variable condenser for wireless telegraphy was also shown, and Sir Oliver Lodge's high-pressure valve for obtaining unidirectional current through X-ray tubes. The condenser consists of a set of fixed vanes interleaved with a set of movable vanes; the latter are actuated by a milled head, to which is attached a pointer travelling over a divided scale. This allows a very fine adjustment to be obtained, giving very accurate tuning for wireless telegraphy. The vanes are enclosed in a glass vessel, which may be filled with oil if desired.

Messrs. Crompton & Co., Ltd., showed their well-known standard potentiometer, a beautiful instrument, which has been developed by degrees to a pitch of accuracy and convenience little short of perfection; their portable pyrometer which was recently described at some length in our pages; a portable voltmeter of the moving-coil type, with zero adjustment operated from outside, and a large range of voltages, the resistances being within the instrument; and a portable slide-wire for use in localising faults in electric light mains and similar purposes. The latter apparatus consists of a slide wire about 150 in. long, coiled on an insulating drum: if the drum is revolved, a contact is made at any point required between the terminal ends of the wire. The slide wire is oil immersed, and the wire and contacts keep perfectly clean.

Messrs. Evershed & Vignoles, Ltd., exhibited a complete range of their Meggers for testing insulation; the Bridge-Megger for measuring resistances down to 1 ohm, and their portable combined ammeters and voltmeters for ordinary current and pressure tests. The hand generator of the high-range Megger gives a constant pressure of 1,000 volts, and the scale extends from 1,000 to

10 megohms. These instruments have already been described in our columns, and are too well known to require detailed notice.

MESSRS. NALDER BROS. & Co. showed the N.C.S. ballistic galvanometer, bridges, Universal potentiometer (which consists entirely of adjusted resistances, having no slide-wire), and a variety of standard apparatus. Their new pattern double testing set, which is used for measuring both copper and insulation resistance, calls for special mention; it comprises a delicate galvanometer and three dials, with a set of ratio coils giving powers from 100 to ·01 by the simple device of pressing the galvanometer key on the particular stud which corresponds to the desired multiplying power. With this apparatus resistances can be measured from 0·01 to 111,000 ohms; insulation resistances can be ascertained by direct deflection, any pressure up to 500 volts being used, and the range with 100 volts being 2,000 megohms; capacity tests can also be made and faults localised, with this set. Lastly, we must mention Mansbridge's variable standard of self-induction. This instrument (designed and patented by Mr. Mansbridge, of the Postal Telegraph Department, and manufactured by Messrs. Nalder Bros.) consists of compound-wound D-shaped coils, two of which are embedded in a lower ebonite disk and two in an upper ebonite disk. The compounding of the coils enables a much greater range of inductance to be obtained in one instrument, and the special shaping of the coils gives a scale of practically equal divisions throughout; this is a point of considerable importance, as the difficulty of obtaining accurate adjustments when the scale adjustments towards one part of the scale come very close together is well known.

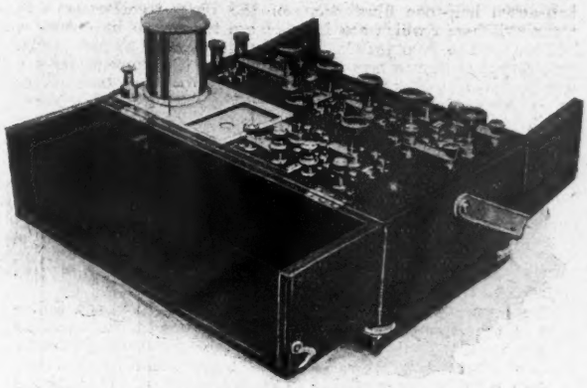


FIG. 17.—NALDER DOUBLE TESTING SET.

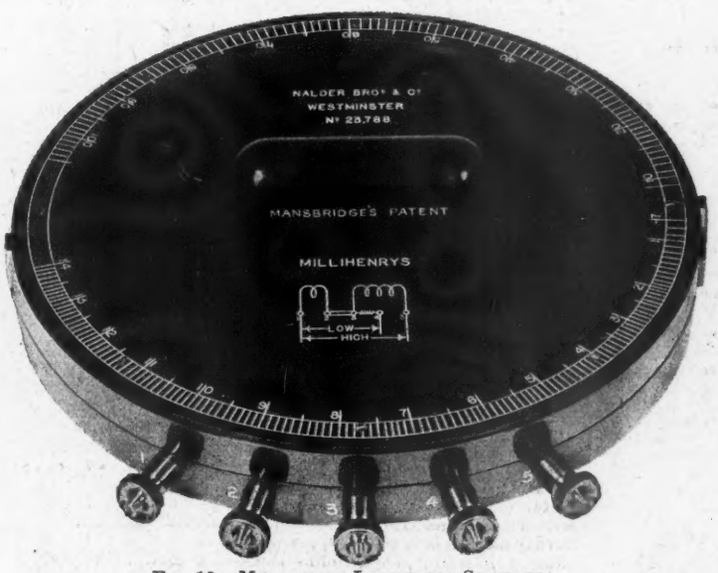


FIG. 18.—MANSBRIDGE INDUCTANCE STANDARD.

For the higher range of inductance (9 to 105 millihenrys) the two sections of the compound winding are used in series, all the four coils being also connected in series. For the lower range (·7 to 12 millihenrys) the greater part of the winding of each coil is cut out, a compensating non-inductive resistance being provided so that the change from the high to the low range can be made without disturbing the bridge balance. A special terminal is, however, provided so that connection can be made direct with the low-range coils where a high time constant is an advantage.

MESSRS. ROSS, LTD., showed optical apparatus, and an arc lamp for laboratory work.

MESSRS. W. CLARK, FISHER & WADSWORTH had an exhibit comprising a wattmeter for standardising purposes, reading to 0·01 watt; a flux standard, for calibrating ballistic galvanometers; a pyro-potentiometer having a range of 600° C. in sixtieths of a degree; a pyrometer bridge reading to 2,100° C. to tenths; a Broca galvanometer with adjustable damping, a resistance comparator, and various other apparatus.

MESSRS. GAMBRELL BROS. had a low-resistance box, range 0·1 to 11 ohms, capable of carrying 4 or 8 amperes; a series and parallel resistance box, reading from 0·1 to 10 ohms, capable of carrying from 3 to 30 amperes; a new-pattern moving-coil galvanometer, Savage's cable-testing key, and minor apparatus.

THE CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD., exhibited Callendar & Griffiths's bridge for thermometric work of high accuracy, a potentiometer for similar work, a Broca astatic galvanometer, Duddell's patent sensitive thermo-ammeter for small alternating currents, and other instruments.

MESSRS ELLIOTT BROS. showed Harrison's Universal photometer; resistance bridges; the "Century" mains-testing set, with which all the tests likely to be required in laying and maintaining underground cables over a wide range can be carried out; an improved form of fault-localising bridge, with slide wire; and a variety of minor apparatus. Some of the die castings, of an alloy of aluminium and zinc, of which Messrs. Elliott Bros. have made a speciality, were exhibited; they are exceedingly accurate and well finished, the dimensions being true to within 0·01 in., and not only difficult and complex shapes, but even screw threads, gear wheels, and ratchet teeth and holes are accurately cast, needing no further machining. The principal feature of the exhibit was a stand of speed indicators for motor-cars, of improved and simplified design; some of these were working. Provision is made in the driving mechanism for readily adjusting the gear ratio to suit tires of different diameter, a simple form of friction-drive being used. A view of this device is given herewith (fig. 19).

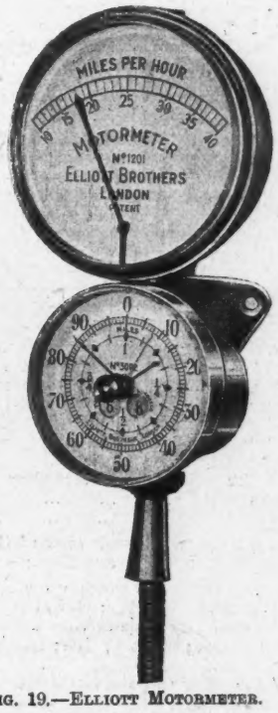


FIG. 19.—ELLIOTT MOTORMETER.

Gas Fatalities.—On Christmas day three men staying at a Swansea hotel were found to be dead, and a fourth unconscious. Death was due in each case to suffocation caused by escaping gas. When the men went to bed late on Tuesday night the gas was turned off at the meter, but it was turned on again in the morning, probably when the men were asleep. Four men also were recently fatally poisoned by an escape of gas at night.

Electrical Production of Steel.—The R. Lindenberg Co., of Remscheid, announces the completion and setting in operation of a new plant. This comprises principally a material extension of the electro-steel works and the establishment of an extensive rolling mill plant with heavy, medium and light trains. Apart from this development the Eich Ironworks Association of Le Gallais-Metz & Co., Eich, near Luxemburg, has convened an extraordinary general meeting to consider resolutions for the adoption of the system of steel manufacture in electric furnaces. The particular method proposed is that of the Kjellin induction furnace as improved by the firm of Rochling Bros.

BUSINESS NOTES.

The Commonwealth Tariff.—Under this title the *Times* of December 26th gives particulars of the new Australian tariff, as passed by the House of Representatives. The Prime Minister is reported to have said that the preference proposed at present covers £15,000,0000 worth of British goods. Amongst the items of interest to the electrical trades are the following, with the general tariff, and that on British goods, respectively :—

	General.	British.
Arc lamps and incandescent lamps, *ad. val.*... ...	5 %	Free
Metal reflectors and shades	25 %	15 %
Motive-power machinery and appliances, except electric, including gas producers, economisers, mechanical stokers, steam traps, steam turbines, superheaters, and water purifiers	5 %	Free
Machine tools	25 %	20 %
Mixed metalware and plateware n.e.i.	25 %	20 %
Manufactures of metal n.e.i.	25 %	20 %
Brasswork and gun-metal work for general engineering trades	30 %	25 %
Screws with nuts, set screws, &c.	25 %	20 %
Rotary and percussive rock drills	20 %	15 %
Coal-cutting machines	5 %	Free
Electrical machines, appliances and parts thereof :—Electrical apparatus and fittings, consisting wholly or partly of metal n.e.i., including switch fuses and lightning arresters, electric heating and cooking appliances	15 %	10 %
Generators for direct coupling to steam turbines ...	5 %	Free
Electrical appliances n.e.i. (including arc lamp and vapour lamp accessories)	15 %	10 %
Electrical articles and materials, viz. :—Accumulators or storage batteries, arc lamps, arc lamp carbons, cable and wire covered, carbon in blocks of 12 sq. in. and over, electrical vacuum tubes, measuring and recording instruments, prepared insulating tape	5 %	Free
Rails, fish plates, fish bolts, tie plates and rods, switches, points, crossings, and intersections for railways and tramways	15 %	10 %
Iron pipes, cast and wrought, n.e.i.	40 %	30 %
Rolled iron or steel beams, channels, joists, girders, columns, trough and bridge iron and steel, not drilled or further manufactured; shafting, cold rolled, turned or planished...	17½ %	12½ %
Bolts, nuts, rivets, and washers n.e.i.	25 %	20 %
Anodes and hooks for plating purposes	5 %	Free
Steel and steel-rimmed wheels of over 18 in. diameter in the tread for trucks and wagons, and all steel parts for such wheels	5 %	Free
Mineral lubricating oil, per gal.	3½d.	3d.
China, Parian and porcelain ware	25 %	20 %
Glass cells for primary and secondary electric batteries	5 %	Free
Belting	25 %	20 %

Duties which are to supersede some of the foregoing on dates to be fixed by proclamation are as follows :—

Engines n.e.i; turbines; winches n.e.i.; boilers n.e.i.; pumps; windmills; elevating and conveying machinery; pile-driving plant; economisers; cranes; presses; lifts; machines and machinery	32½ %	27½ %
Machinery and machines; and machine tools n.e.i...	27½ %	22½ %
Manufactures of metal n.e.i.	32½ %	27½ %
Mining engines and machinery n.e.i...	37½ %	27½ %
Rails, fish plates, fish bolts, tie plates and rods, switches, points, crossings and intersections for railways and tramways	22½ %	17½ %
Iron pipes, cast and wrought, n.e.i.	32½ %	27½ %
Rolled iron or steel beams, channels, joists, girders, columns, trough and bridge iron and steel, not drilled or further manufactured; shafting, cold rolled, turned or planished	22½ %	17½ %
Bolts, nuts, rivets and washers n.e.i....	32½ %	27½ %
Plates (except plain tin) and sheets and pipes and tubes of any metal, tinned-plated, polished or decorated	20 %	—

Catalogues, Calendars, &c.—THE ELECTRICAL POWER STORAGE CO., LTD., 4, Great Winchester Street, E.C., send us their usual blotting-pad and desk diary, of substantial proportions, and with blotting paper of excellent quality. The diary has a fortnight to an opening, and is inter-leaved with blotting paper, while it carries a £500 accident insurance policy, and contains a quantity of useful information. At the top of the pad is a monthly calendar. This well-known New Year souvenir is a very useful article.

THE KEY ENGINEERING CO., LTD., 38, Deansgate, Manchester.—Calendar for 1908, on four cards, decorated respectively with views of large gas engines, fibre conduits, Andrews switch-gear, and the Co.'s Trafford Park Works.

THE BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough.—Tear-off motto calendar for 1908, attached to a large reproduction in colours of a painting by E. R. FOX—"In the Power House," showing a Brush double-current generator driven by a Brush three-crank engine. The same picture was reproduced on the front cover of "The Book of the Brush Engine" recently, and forms a very suitable decoration for the wall of an engineer's office.

THE BRITISH ELECTRIC TRANSFORMER CO., LTD., Hayes.—We have again received from the makers of the Berry transformer a handsomely bound copy of Whitaker's Almanack for 1908, than which there is no more welcome or useful Christmas gift. The half-dozen half-tone illustrations of the Berry transformers and series switch-gear which are inserted are too few to be obtrusive and too good to be objectionable; we note amongst them a special patent type of transformer for use with metallic filament lamps, a timely innovation, for it is well worth while to put in a transformer in order to secure the best results from the high-efficiency lamps now available. "Whitaker" is so frequently required for reference that no better vehicle for the purpose of a memento could be desired.

MESSRS. T. W. BROADBENT, LTD., Victoria Electrical Works, East Parade, Huddersfield, have sent us a wall calendar for 1908, bearing an excellent reproduction of a painting by Elias, "Harvesting in Hertfordshire." The company have a limited number to distribute to their friends, on application.

MESSRS. W. HARVIE & CO., LTD., 24, McAlpine Street, Glasgow.—Calendar for 1908, with pretty landscape in colours.

THE GENERAL ELECTRIC CO., LTD., Queen Victoria Street, E.C.—One of the most generally useful souvenirs which has made its appearance this Christmas must be credited to the General Electric Co. It takes the form of a handsome leather folder, with several pockets suitable for envelopes, loose papers, &c., and containing a blotting pad of ample proportions. As the folder is flexible and will carry foolscap sheets with ease, it forms a more than usually convenient adjunct to the writing desk, its portability adding to its other useful features. We are also in receipt of the company's new 12-pp. catalogue of Osram fittings and accessories, in which adaptors, pendants, and fittings for this popular lamp are fully illustrated and priced; and of No. 70 Progress Sheet, containing particulars and illustrations of motor-generators supplied to the L.C.C. Tramways Department; also of testing instruments, switches, fittings, heating apparatus, and telephonic apparatus. A full list of the company's publications is appended, which should prove useful for reference.

THE D.P. BATTERY CO., LTD., Bakewell, Derbyshire.—Wall calendar, ornamented with an illustration of the Great Wheels at Lumford Works, where the D.P. storage batteries are made, and small views of the cells, &c. Copies will be sent on application.

MESSRS. WATTS, FINCHAM & CO., Billiter Buildings, E.C.—Pictorial wall calendar for 1908.

MESSRS. SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—*Installation News* for December, 1907, with a pretty photogravure of a wood-nymph swinging in graceful pose; also two insets—an advance price sheet of Simplex glow lamps (carbon filament) of high efficiency, 3 to 3½ watts, and a guaranteed average life of 1,000 hours; these are made in various shapes; and a similar sheet dealing with Simplex luminous radiators of various designs, one of which takes the form of a wall bracket.

MESSRS. POPE'S ELECTRIC LAMP CO., 5, Arthur Street, W.C.—A card perpetual calendar in the shape of the Pope electric lamp, which is made in London.

MESSRS. F. DARTON & CO., Clerkenwell Optical Works, 142, St. John Street, E.C.—New illustrated and priced list of electrical novelties, including numerous designs of small motors, dynamos, fans, boat motors and propellers, model accessories, instruments, lamps, telephones, bells, &c. This list should be particularly useful to model engineers, &c.

From MESSRS. MCCLURE & WHITFIELD, Stockport, we have received a handy leather-backed pocket diary, similar in style, we believe, to those issued in previous years, and containing in addition to the usual memoranda pages, tabulated information of everyday use and insurance coupons, &c.

MESSRS. FERRANTI, LTD., Hollinwood.—New continuous-current meter pamphlet, describing the Hamilton patent type in detail, with excellent half-tone and line illustrations, including some views of the workshops.

Cable Specifications.—The Johannesburg Chamber of Trade is taking steps to secure the adoption of a special label for coils of rubber-insulated cable, in order to prevent the supply of inferior material in unfair competition with British cable of high-class quality.

Manchester Electrical Exhibition.—Mr. H. Talbot, president of the Municipal Electrical Association, has accepted a seat on the Exhibition Committee to represent the interests of the Association, as well as of the Nottingham Corporation, which is supporting the scheme.

Entertainment.—A smoking concert was held by some members of the staff of MESSRS. FERRANTI at the Queen's Hotel, Hollinwood, on the 19th ult. About 22 were present, and a very pleasant evening was spent, wound up by Mr. Victor Campbell, the chairman, with one of his typical Scotch speeches.

Bankruptcy Proceedings.—ERNEST EDWIN LLOYD, electrical fitter, Central Chambers, Bilston.—A statement of the affairs of this debtor issued by the Official Receiver shows gross liabilities £151 9s. 5d. due to 25 unsecured creditors, and the whole sum is expected to rank for dividend. The assets consist of only £1 in respect of life policies, so that the deficiency is £150 9s. 5d.

Motor Starters.—Referring to our notice of MESSRS. HAMILTON BROS.' new leaflet on motor starters, &c., the firm point out that they make the "W. H." standard starters not only from ½ to 7½ H.P., but from ½ to 40 H.P., and larger sizes if desired.

Book Notices.—*The Science Year Book*, 1908. Edited by Major B. F. S. Baden-Powell. London: King, Sell & Olding, Ltd. Price 5s. net.—This useful year-book, now in its fourth year, has taken its place amongst those annuals to whose coming one looks forward with pleased anticipation. The tables and data have been thoroughly revised and new tables added; the biographies have been extended, and a summary of scientific progress in 1907 is given. The diary, one page per day, with cash account pages, &c., is a most useful feature of the volume. The directory of scientific and technical periodicals is somewhat behind the times.

Faraday House Journal.—The January number contains a list of appointments secured since the August issue appeared, articles on Modern Sub-station Working, Messrs. Clarke, Chapman's works, Turbo-Alternators, and other interesting items.

"Fire Tests with Fire Extinguishers." "New Era" Extinguishers of the Valor Co., Ltd. Red book No. 124 of the British Fire Prevention Committee. London: The Committee. 1907. Price 2s. 6d.

"Die Drahtlose Telegraphie im Internen Recht und Völkerrecht.' By F. Melli. Zurich: Art Institut Orell Fussli. 1907. Price M3.50.

"On Magnetic Oscillators as Radiators in Wireless Telegraphy." By J. A. Fleming. Excerpt from the Proceedings of the Physical Society of London, Vol. XX.

Curtis Turbines.—The County of London Electric Supply Co., Ltd., have placed an order with the BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, for a Curtis turbo-generator set of 2,500 KW. capacity, complete with sub-base condensing plant, for their City Road station, London. This is the fifth contract and the sixth Curtis turbo-generator set ordered by the County Co. from the British Thomson-Houston Co., Ltd., aggregating 10,000 KW. in capacity.

Inquiry.—A foreign firm of engineers seeks a favourable site for large works, with a cheap supply of electrical energy; see our advertisement columns to-day.

Dissolutions.—Notice is given in the *London Gazette* that Mr. F. J. Robinson and Mr. W. J. S. Jones, formerly carrying on business as electrical and general engineers at 21, Collingwood Street, Newcastle-upon-Tyne, as ROBINSON & JONES, have dissolved partnership by mutual consent as from December 11th, 1907. Debts will be dealt with, and the business carried on, by F. J. Robinson.

The Japanese Exhibition of 1912.—According to the *Times*, the Grand Exhibition of Japan will be opened in Tokio on April 1st, 1912, and will be closed on October 31st of that year; it will be held on a site covering about 292 acres. All foreign Governments and peoples are invited to participate in this exhibition. All articles imported from foreign countries for the sole purpose of exhibition will be admitted free of duty.

Trade Announcements.—MESSRS. DRYSDALE & CO., LTD., intimate that from January 1st, 1908, all business communications should be addressed to them at Bon-Accord Works, Ferry Road, Yoker, Glasgow, W. Telegrams: "Bonaccord, Glasgow."

MR. G. F. METZGER announces that his address is now 22, Cooper Street, Manchester. Telephone No. 5,892. Telegrams: "Metzger, Manchester," as before.

Football.—On Saturday last the Head Office football team of the GENERAL ELECTRIC CO. journeyed down to Witton, Birmingham, to try their luck with their Works team, which holds a very formidable record in that district. On their arrival they were shown the sights of the town, and regaled with a substantial dinner, at which Mr. Wilson, the works manager, presided, after which they paid a visit to the engineering works. The football game was a good one, but the Witton team overpowered the Londoners, winning by 10 to 1. After the game both teams partook of a very welcome meal, which was followed by an impromptu smoking concert, at which Mr. Solomon, the manager of the Carbon Works, presided, and a whist drive. At eight o'clock both teams were driven to the Birmingham Empire, and this concluded the programme. On the previous Saturday the General Electric Co.'s London team had met the Robertson Lamp Works team, and had the misfortune to lose by two goals to one, the winning goal being a penalty. After this match the G.E.C. team were invited to a fancy dress ball at the lamp works and spent a most enjoyable evening.

Thermit Welding.—With reference to the late action of Thermit, Ltd., against Weldite, Ltd., for infringement of the former's patent rights for the production of pure metals and for welding metals by the well-known Thermit process, in which Mr. Justice Warrington in April last gave judgment in favour of Thermit, Ltd., we learn that on Saturday, December 21st, an order was made by Mr. Justice Parker on the petition of Thermit, Ltd., for the revocation of patent No. 10,881 of 1905, granted to Claude Vautin for the process, the use of which by Weldite, Ltd., formed the subject of the above action.

LIGHTING and POWER NOTES.

Australia.—The Melbourne electricity supply is being converted on modern lines. The three existing stations supply A.C. for street lighting, low-pressure A.C. to the suburbs, and D.C. in the city proper. The alternating plant is being reorganised, turbo-generator being installed to supply energy at 4,000 volts to 13 transformer stations to be erected in the suburbs, from which energy will be fed to underground networks at 200 and 400 volts pressure. A 1,100-H.P. D.C. set will shortly be added to the central plant; the boiler plant is being increased and coal bunkers and conveying plant added.

The Cassilis Gold Mine (V.) is being provided with an extensive electrical installation, probably the largest electrical mining plant in Victoria. The plant includes a 400-KW., three-phase generator direct-coupled to a Pelton wheel, and a similar lighting D.C. set of 10 KW. The hydraulic works include a flume 3½ miles long and capable of developing 1,200 H.P. at the power station, which latter is connected to the mine by 16 miles of 12,000-volt transmission line. When extensions are made, a large storage reservoir will be formed, and the transmission pressure raised to 21,000 volts. Two transformer stations are provided at the mine, reducing the pressure to 500 volts, at which pressure the motors for the stamp battery, shops, furnaces, hoists, &c., are operated. The lighting throughout is by electricity, and it is intended to install a testing transformer in conjunction with an electric furnace for experimental smelting.

The Kalgoorlie Electric Power and Lighting Corporation has decided to defer the doubling of its plant capacity, owing to the increased expense attaching to the importation of plant under the Federal tariff. The tariff is expected to operate adversely with the company's consumers who will also defer the ordering of plant from abroad for similar reasons. Suitable plant of Australian make cannot be obtained, and in any case could not be produced at market prices.

Belfast.—The total number of units sold during the year for all purposes was 10,732,000, as against 9,222,000 in the previous 12 months, or an increase of 16·3 per cent. The engineer reports to the T.C. that the period of maximum pressure has been passed through, and in spite of the labour troubles, he was of opinion that the year was highly satisfactory. He further explained that the cable purchased recently from a German firm at £270 was as good, in his opinion, as the English cable at £560.

Brixham.—Owing to the unsatisfactory result of the canvass, no steps will be taken towards providing a supply of electricity for the town.

Cobham.—The P.C. has decided to offer no opposition to the application of the Woking Electrical Supply Co. for a prov. order for E.L. for the parish.

Continental Notes.—FRANCE.—The Socialist Municipality of Toulon owes the Electric Lighting Co. some £16,000, and has refused to pay. The company has now placed a baliff in possession of the town hall, and threatens—failing payment of the debt in one week—to cut off the supply, and leave the town in darkness.

Douglas (Isle of Man).—The T.C. has decided to ascertain the cost of the plant, &c., necessary for public and private E.L., and the cost and advisability of obtaining power for turbines from the West Baldwin reservoir or by any other means.

Exeter.—The engineer estimates that the capital expenditure for three years from March 31st, 1908, will be as follows:—On mains, £8,100; on transformers and switchgear, £900; on meters, £800; total, £9,800, against which the Council has a balance of sanctions on the two latter items of £600. On the recommendation of the Electric Lighting Committee, application is to be made to the L.G.B. for sanction to the borrowing of the moneys estimated.

Hanwell.—The B. of T. has informed the U.D.C. that unless it is shown at the end of 12 months that it is intended to do something with the E.L. Order, the latter will have to be revoked. The Council has received an offer to take over the order, made by the Metropolitan Electric Supply Co., who offer to supply energy for the offices and the Free Library at 4d. per unit.

Heswall.—The R.D.C. has ratified the agreement between the P.C. and Messrs. Robinson & Carter, for the provision of an electrical supply for the parish.

Heysham.—The B. of T. has informed the U.D.C. that it has deferred the consideration of the question of revoking the E.L. order for a year.

Horbury.—The *London Gazette* contains a notice of the revoking of the electric lighting order, 1903, as from December 19th last.

Ilford.—The Council has decided to erect large tantalum street lamps down Ilford Lane from the termination of the arc lighting, to Loxford bridge. Extensions of arc lighting are also to be considered shortly.

Spalding.—The district auditor has surcharged members of the U.D.C. with the sum of £66 expended in opposing the application of a company for E.L. powers, on the ground that the

L.G.B. was not notified of the action the Council were taking in the matter. The Council has its own E.L. order, but has not yet carried it out.

Tamworth.—The T.C. has agreed to accept £300 from the B.E.T. Co. for the release of the latter from the obligation to the Council incurred by the Shropshire Electric Traction Co. The order will now revert to the Council.

Tewkesbury.—The T.C. has entered into an agreement, subject to the consent of the B. of T., for the transfer of the E.L. order to Mr. John Parker, of Hereford, who will pay the Council's costs up to £300.

Wellington (Salop).—The U.D.C. has informed the B. of T. that the proposed transfer of the E.L. order to the Shropshire Electric Power Co. cannot be carried out, as the company had agreed to sell its undertaking to the B.E.T. Co., which has no power to take over the order.

Wigan.—The *London Gazette* contains a notice of the revoking of the Wigan Rural District Council electric lighting order, 1903, as from November 30th last.

Wimbledon.—The E.L. Committee has decided in favour of a sum of £639 in addition to the £1,500 already voted in relief of rates, being transferred from the electric lighting account to the general district fund. As a result of the engineer's report on the cost and efficiency of tantalum, Osram and carbon filament lamps for street lighting, it has been decided to continue the existing system, but to gradually substitute a 32-C.P. lamp for the two 16-C.P. carbon filament lamps now used per post.

TRAMWAY and RAILWAY NOTES.

Accrington.—The new electric tramway as far as St. John's Church, Baxenden, was formally opened for public traffic last week-end. The Mayor drove the first car, and was accompanied by a number of Councillors, Mr. Gray, manager of the electrical department, and Mr. Wilson, tramway manager. The rest of the lines to the boundary are now practically completed.

Australia.—Mail advices received on Saturday, state that on November 26th, a conference took place in Melbourne between the Federal Postmaster-General, the chairman of the Victorian Railway Commissioners, and Mr. Merz, the electrical expert from England. The last named made it clear that the electrification of the suburban railway lines would be begun very soon, and that the effect of the installation of electrical traction would be to render the telephone service, as it at present exists, practically useless, and that an expense of £100,000 would have to be incurred by the Postal authorities to install metallic circuits. The Postmaster-General agreed to recommend the Federal Cabinet to consent to the necessary work being carried out for the establishment of metallic circuits.

Birmingham.—An approximate estimate of the year's tramway traffic shows that over 70 million passengers were carried on the Corporation cars, the receipts amounting to nearly £284,000.

Bradford.—Owing to a trolley pole leaving the wire on the Corporation's Low Moor tramway route, three passengers were injured, one of whom died from a fractured skull.

Clitheroe.—The R.D.C. has decided to offer the strongest opposition towards the application by the Blackburn, Whalley and Padiham Light Railway promoters for a revival and extension of time for those railways.

Colwyn Bay.—After considerable discussion the U.D.C. has agreed, with a view to facilitating the completion of the light railway through the town, to allow of the use of tar macadam for the whole of the route, dispensing with wood paving on certain portions.

Continental Notes.—GERMANY.—Among the display of electrically-operated vehicles on view at the recent Automobile Exhibition held in Berlin was an electric omnibus, constructed by the Siemens-Schuckert Works. The 'bus is a single-deck vehicle, fitted with a motor and battery, one charge of the latter being sufficient for a distance of 25 miles. The weight of the battery is 14 cwt., and the capacity is 244 ampere-hours with a discharge extending over five hours. The motor drives the rear wheels by means of gearing, and is said to be capable of propelling the 'bus up gradients of 8 per cent.

It is announced from Essen, in the district of the Ruhr, that the State Railway Administration is about to make an experiment with electric traction on the line between Osterfeld and Dahlhausen, which is to be extended to Hattingen, on the introduction of the summer train service. The passenger traffic on this railway is only of slight dimensions, and this is probably the reason for the decision to order merely four motor coaches, each having accommodation for 100 persons. Each coach is to be equipped with a 50-H.P. motor and batteries which will have a capacity of 368 ampere-hours. It is intended to procure a supply of energy from the Essen electricity works, and the batteries will be recharged at the Heissen station during the night. The speed of the motor coaches, for which orders have already been given, is to be 25 miles per hour.

Negotiations are in hand for the construction and working of an electric tramway between the towns of Barmen and Hasslinghausen.

SPAIN.—An application has been made for a concession to construct and work an electric tramway between Vigo and Lavadores.

FRANCE.—An accident occurred recently in a caisson on the Paris Underground Metropolitan Railway, where a tunnel is being built under the Seine in connection with a new line, and five men were drowned.

Finchley.—Negotiations are proceeding between the U.D.C. and the County Council with regard to the proposed tramways in Regent's Park Road, Ballard's Lane and Woodhouse Lane. A number of points have been settled, but six objections raised by the local authority have not yet been satisfactorily met by the County Council.

Glasgow.—An important report has been issued by Mr. Dalrymple on the question of a through route from Maryhill to Springburn—a total length of route of nearly three miles, which would cost for track and equipment (exclusive of power plant, depôts, &c.) some £43,000. He comes to the conclusion that these extensions would entail a working loss, as in the case of certain other outlying extensions which, in distinction to the proposed routes, passed through well populated areas. After consideration, it was decided to delay in the meantime the construction of the lines.

Halesowen.—The Light Railway Commissioners have submitted to the B. of T. for confirmation an order transferring to a company the powers conferred upon the Halesowen R.D.C. by prov. orders of 1901 and 1902.

London.—During Christmas week two tramway accidents occurred on the L.C.C. tramways. On the evening of December 25th, the brakes of a car on Pentonville Hill, failed to act, and it dashed into a stationary car, standing near King's Cross, eight persons being slightly injured. The second collision occurred on December 27th, between an electrical and a horse car, at the corner of Old Street, resulting in the derailing of the horse-drawn vehicle, and injury to three persons.

As a result of the investigation of the charge of manslaughter brought against William John Hollis, the signalman concerned in the West Hampstead collision on October 25th last, Mr. Plowden (Marylebone Police Court) committed Hollis for trial, bail being allowed.

South Shields.—The Corporation and the Jarrow and Shields Light Railway Co. are reported to have come to terms in respect to the latter company having running powers over the Corporation's lines from Tyne Dock to the South Shields Pier. It is understood that there will be a 20 minutes' service, and the cars used will be those of the Jarrow Co., for which 3·6d. per car-mile will be allowed. Approximately the distance from Tyne Dock to the Pier is 2¼ miles, so that the Corporation will pay to the company about 8·1d. for each car journey. The tickets will be sold to the company by the Corporation. In the case of through fares the money will be divided between the company and the Corporation.

U.S.A.—NEW YORK.—A new type of tramway car is being tried in the city, having separate entrance and exit doors. The conductor stands at the former, and takes the fares as the passengers enter the car.

TELEGRAPH and TELEPHONE NOTES.

Servia.—In a recent report on the trade of Servia in 1906, the Austrian Consul at Belgrade states that in that year 1,227,282 internal telegraph messages were sent, and 190,039 foreign messages, or a total of 1,417,321. The length of telegraph line at the end of 1906 amounted to 3,439 km., an increase of 158 km.: the length of line was 8,119 km, an increase of 394 km.; the number of stations amounted to 147, an increase of 1; the number of apparatus to 275, the number of posts to 69,483 and the number of insulators to 171,440.

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo	Closed..	Jan. 12, 1908 .. ..
Lagos-Kotonon	Dec. 4, 1907 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Brest-Dakar	July 22, 1907 ..	..
Cueta-Tangier	Dec. 7, 1907 ..	..
Bathurst-Bissao	Dec. 25, 1907 ..	..
Landlines.		
Puerto-Barrios	Aug. 2, 1902 ..	..

Canada.—The Manitoba Government has purchased the property and lines of the Bell Telephone Co. in Manitoba for £666,000.

Telephoning to Submarines.—As a result of experiments carried out with a view to providing submarines with buoys fitted with telephonic apparatus, in order to enable the crews to communicate with the surface in case of accident, the French Minister of Marine has ordered the adoption of metallic floats of great buoyancy, capable of withstanding the pressure of water at a depth of 50 metres. These floats will be fitted to all vessels in commission or in the dockyards as speedily as possible.

Wireless Telegraphy.—It is reported that the small portable military station for wireless telegraphy at Korneuburg near Vienna recently succeeded in receiving a message of 1,000 words from the large station at Nauen, which is situated about 24 miles distant from Berlin. The Austrian station merely consists of a tent and wagon with the apparatus and a mast 148 ft. high, and its normal scope of action is 37 miles. It appears that the Nauen station came to an understanding with those in charge at Korneuburg in regard to the despatch of a message, and intimated the wave length so that the Austrian station might tune its receiving apparatus accordingly. This was done, and out of the lengthy communication only two words, it is said, were illegible, the distance of transmission being about 370 miles. Hitherto the Nauen station has been able to transmit over a distance of 1,674 miles, but as the 35-H.P. plant has now been replaced by one of 70 H.P., it is expected that the range of correspondence will be materially increased, and vessels belonging to the Hamburg South American Steamship Co., which are already equipped with apparatus, will shortly be utilised for this purpose. The plant at the Nauen station is now able to produce 50 sparks per second.

It is reported that M. Berjonneau, a French engineer, has invented a system of transmitting photographs by wireless telegraphy.

The Spanish Government proposes to erect 32 wireless telegraph stations round the coast of Spain.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ALNWICK.—Villa at Eglingham for T. Greener. M. T. Wilson, architect and surveyor, Alnwick.

ASHTON-IN-MAKERFIELD (LANCS.).—Motor house for the Garswood Hall Colliery Co.

Residence in Wigan Road for Dr. Cobban.

BIRKENHEAD.—New schools in Henningford Street for the T.C. (£16,829).

BIRSTALL (YORKS.).—New Roman Catholic Church in Kirkgate for Father Russell.

BLACKPOOL (BISPHAM).—Semi-detached houses for Mrs. Shorrocks, Mr. Midgley, Mrs. Whiteley and Mr. T. H. Knight.

BOGNOR.—Proposed works at the Infectious Diseases Hospital (£2,000).

BRIXHAM (DEVON).—Houses and shops in Fore Street for the Lord of the Manor. F. W. Vanstone, architect, Palace Chambers, Paignton.

BROADSTAIRS.—Golf club house at St. Peter's for W. Capel Slaughter.

BROUGHTY FERRY (DUNDEE).—Semi-detached villas for C. Stephen. R. G. Murray, architect, Dundee.

BUCKHAVEN (FIFE).—Twenty-four houses in College Street. Robert Durie, Methil, Fife.

BURNHAM (SOMERSET).—New Golf Links Hotel. B. C. Board, Burnham.

BURSLEM.—New theatre in Liverpool Road to seat 2,500 persons.

BURY.—New Salvation Army barracks in Moorgate and Bambury Street.

CAMBRIDGE.—Houses on Abbey Estate for Halingway, Clark & Sons.

CARRICKMACROSS (Co. MONAGHAN).—Intermediate schools. J. V. Brennan, C.E., Belfast.

CHEAM (SURREY).—Twelve houses in Norman Road, for G. Price, Russell House, Grange Road, Cheam.

CHORLEY.—Extensions to the works of the Chorley Bleaching Co., Ltd., Common Bank.

CLACTON-ON-SEA.—Additions to St. Paul's Hall.

CLITHEROE.—Ten houses for the Ribblesdale Friendly Aid Society.

CROYDON.—Additions to Congregational Church. F. Downing, 12, King's Bench Walk, E.C., architect.

Additions to 8 and 10, George Street. Berney & Sons, 104, George Street, Croydon, architects.

DEVONPORT.—New laundry at the Workhouse.—Thornely & Rooke, architects, 29, St. Aubyn Street, Devonport; and 11, The Crescent, Plymouth.

DONCASTER.—New Branch Grocery Stores for the Pontefract Industrial Society, Ltd., South Elmsall. Garside & Pennington, architects, Pontefract and Castleford.

DOVER.—Public buildings to be wired for E.L. for the T.C.

DUNDEE.—Alterations at East Poorhouse. J. and J. Kidd, builders, Dundee.

DUNFERMLINE.—Alterations on property for H. M. Pearson, solicitor, Dunfermline.

EARLSWOOD (SUSSEX).—Rebuilding N.E. block of Asylum (£6,000).

EGHAM.—Additions to "Clouboy," for Viscountess De Vesci.

EPSOM (BANSTEAD).—Six shops in Station Road, Tadworth, for Thorne, Trehearne & Norman.

FALKIRK.—Extension of the Municipal Buildings for T.C. (£3,755).

FOLKESTONE.—Important additions to the Victoria Hospital.

Semi-detached houses in Burry Road. T. W. Elworthy, architect.

GALWAY.—Proposed Technical Institute.

GLASGOW.—New store for J. & P. Coats. Central Agency, Bothwell Street, Glasgow.

Extension of ironfounders' works for A. & J. Main, Ltd., Petershall Road, Glasgow.

Buildings in Washington Street for J. Buchanan & Co., Ltd., Holborn, London.

Proposed new church hall in Westland Drive in connection with Whiteinch Primitive Methodist Church.

GRAVESEND.—New schools to be lit by electricity for the T.C. J. J. Robson, architect.

GRINDLEFORD (DERBYSHIRE).—Proposed new church (£8,000). E. R. E. Sutton, architect, Bromley House, Nottingham.

HAMPTON.—New All Saints' Church, Marling Park.

Red Lion Hotel to be rebuilt.

HASLINGDEN.—New Council school at Helmshore (accom. 600).

HENDON.—Three new streets off North End Road. W. J. King, North End Road, builder.

HERNE BAY.—Maisonettes in Fleetwood Avenue for A. Wilson.

Three bungalows for C. F. Hunter, Glen Avenue.

Accumulator room, Mortimer Street, for A. E. Hunt & Co., motor dealers.

HERTFORD.—New municipal buildings. Ch. Carter, architect, Nottingham.

ILFORD.—Additions to school (£600). H. Shaw, surveyor to the U.D.C.

Houses and warehouse in Clements Road for Mrs. C. W. Clarke.

ILFRACOMBE.—New Council school for Devon C.C. (£4,000). R. Pickett, builder, Ilfracombe.

IONA.—Restoration of Iona Cathedral. Kintyre Presbytery, Campbeltown.

KIRKCALDY.—New Baptist Church at Pathhead. Rev. G. A. Wilson, minister.

KNUTSFORD.—House for E. Hewitt, architect, Temple Chambers, 29, Brazennose Street, Manchester. Redfern Bros., builders, Knutsford.

LANCASTER.—Equipment of electrical laboratory at the Storey Institute for the T.C.

LEEDS.—Conversion of tramway offices in Boar Lane into ladies' waiting room, &c. T. Lancaster, city engineer, Municipal Buildings, Leeds.

Pair of semi-detached villas in Sandhill Lane, Moortown. G. W. Atkinson, architect, 1, Mark Lane, Leeds.

LONDON.—(HAMPSTEAD WAY).—Five houses. Scrutton & Crebbin, Becktor Road, agents.

(GOLDER'S GREEN).—Ten houses. Vernon Hart, Burgess Park, N.W., builder.

(SOUTH KENSINGTON).—Alterations, &c., at mansion in Lowther Gardens. John Anderson, 4, Clareville Grove, Onslow Gardens, S.W., contractor.

(EALING, W.).—New public schools in Mattock Lane for the T.C.

(MAYFAIR).—Rebuilding 17, Brook Street. John Garlick, Ltd., 43, Sloane Street, W., builders.

(GREAT PORTLAND STREET, W.).—Shops and flats. Bath Stone Firms, Ltd., Bath, builders.

(EAST HAM).—Extension of infectious diseases hospital for the T.C. (£6,970).

(GREAT PORTLAND STREET, W.).—Building on site of No. 209. F. and H. Higgs, Loughborough Junction, S.E., builders.

(W.).—Flats in Molyneux Street. J. C. Casse, Hampton Wick, builder.

(BISHOPSGATE STREET WITHIN).—Extensive buildings. G. Trollope and Colls, Ltd., 77, Grosvenor Road, S.W., builders.

(BISHOPSGATE STREET).—Buildings. Ashby & Horner, 8, Aldgate, E., builders.

(BISHOPSGATE STREET).—Buildings on site of Gresham House. E. Laurance & Sons, 14-16, Wharf Road, City Road, N., builders.

(E.).—Additions to Stepney Central Hall. G. Parker, Sumner Road, Peckham, builder.

(E.).—Buildings at corner of Whitechapel Road and Goulston Street. Ford & Walton, 242, High Road, Kilburn, N.W., builders.

(W.).—Rebuilding shop, &c., in Woodstock Street. Garratt, White and Poland, 16, Hanover Street, W., agents.

(MAYFAIR).—Rebuilding 37, Brook Street. Matthews, Rogers & Co., 1, Green Street, Park Lane, W., agents.

(WALTHAMSTOW).—Extension of public library (£7,500). J. W. Dunford, 100c, Queen Victoria Street, E.C., architect.

(COVENT GARDEN).—Extensive buildings in Bow Street. Howard and Co., 1, Bank Buildings, Bow Street, W.C., agents.

(HAMPSTEAD).—Additions to "Kenmore," Bishop's Avenue, N.W., for P. A. Bauman.

(W.C.).—Buildings in Drury Lane. J. & M. Patrick, Wandsworth, builders.

(KINGSWAY).—Buildings. Gordon & Gunton, Finsbury House, Blomfield Street, E.C., architects; Ford & Walton, Kilburn, builders.

MANCHESTER (GORTON).—Proposed new Wesleyan Methodist Church.

MERTHYR TYDFIL.—Important additions to Pant and Penydarren schools for the T.C. J. Ll. Smith, architect, Central Chambers, Merthyr Tydfil.

MONTROSE.—Alterations to school at Hillside. W. C. Walls, clerk of Hillside School Board, Montrose.

NESTON, SO. (CHESHIRE).—New Council School (£4,000).

NEWBURN-ON-TYNE.—New public school for Northumberland C.C. C. Williams, secretary to the Education Committee, Pearl Buildings, Newcastle-on-Tyne.

OLDBURY.—New Council Schools at Warley for the U.D.C. Education Authority.

NORBURY (SURREY).—Flats in London Road. F. Chown & Sheffield, Norbury, surveyors.

OLDHAM (EAST CROMPTON).—New spinning mill.

PENRITH.—Block of houses for Glasson Breweries, Ltd. Geo. Watson and Son, architects, Penrith.

PONTARDAWE.—Alterations to the Cross Inn Hotel and the Dillwyn Arms Hotel.

POOLE (BOURNE VALLEY).—Proposed new Primitive Methodist Church and Sunday Schools.

PORTSMOUTH.—Reception station and recruiting office in the southern command. H. B. Measures, Director of Barrack Construction, War Office, 80, Pall Mall, S.W.

PRINCES RISBOROUGH (BUCKS.).—New Home for Waifs and Strays.

PWLLHELI (ABERSOCH).—Residence for Mrs. Hughes, Rose Villa, Abersoch.

ROCHDALE.—Proposed branch baths (£7,500). S. S. Platt, borough surveyor, Town Hall, Rochdale.

READING.—Alterations and additions to the Royal Berks. Hospital, under consideration.

RISHTON (LANCS.).—Thirty-one houses in Stourton Street for R. and J. R. Butler.

ROCHDALE.—New Church Army and Central Hall (£3,000). A. Molesworth, secretary.

SANDHURST.—New cadet blocks and administrative block at the Royal Military College. H. B. Measures, Director of Barrack Construction, War Office, 80, Pall Mall, London, S.W.

SHIPLEY.—New Wesleyan Church at Hall Royd (£5,000).

SLOUGH.—New Roman Catholic Church. Mother Superior of St. Bernard's Convent.

SOUTHEND-ON-SEA.—Development of building estate for Col. Burges, Thorpe Hall, Southchurch. Beadel, Wood & Co., 97, Gresham Street, London.

SOUTHPORT.—New Council schools for the T.C. Cheers & Smith, architects, Blackburn.

STAFFORD.—Proposed Wesleyan chapel in Rowley Street.

STOCKPORT.—Extensive works at Bramhall Moor for Mirrless, Bickerton and Day, Ltd., engineers. Chas. Day, managing director.

STOKE-ON-TRENT.—Ten houses in Linley Road, Hartshill, for Jones and Hilton.

Proposed Central Pottery School for Staffs. C.C.

Additions to works for Robinson & Leadbeater, parian manufacturers.

TIPTREE.—Public elementary school. J. H. Nicholas, Secretary, Essex Education Committee, Chelmsford.

TORPOINT (CORNWALL).—Renovation and enlargement of Torpoint Wesleyan Chapel.

TORQUAY.—New General Post Office in Fleet Street. Apply Postmaster.

WAKEFIELD.—Enlargement of the Wakefield Post Office. Apply Postmaster, Head Post Office, Wakefield.

WATERHEAD (near OLDHAM).—New cotton mill. Orme Spinning Co.

WHALLEY (near BLACKBURN).—New brickworks. Lancashire Asylums Board.

WHITEHAVEN.—New laundry at the workhouse. W. H. Atkinson, clerk, Union Hall, Whitehaven.

WOLVERHAMPTON (NEW INVENTION).—New Council schools (£2,615). Thos. Mason, builder, Hednesford.

YORKSHIRE (WEST RIDING).—New schools at Tinsley and Templenewsham; and alterations and additions to schools at East Garforth and Crofton. J. Vickers-Edwards, County architect, County Hall, Wakefield.

CONTRACTS OPEN and CLOSED.

OPEN.

Algiers.—January 10th. The Post and Telegraph Inspector-General requires tenders for 1, 3 and 5 mm. iron wire.

Algiers.—January 10th. Post and Telegraph department. Bronze and copper wire. Particulars by wire to Inspection Generale, or from Colonial Office, Paris.

Ashton-under-Lyne.—The B. of G. proposes to lay down electric light plant for the new hospital and nurses' home, at an estimated cost of £2,250.

Australia.—ADELAIDE, SOUTH AUSTRALIA.—March 11th. The Postmaster-General requires tenders for the supply of one common-battery switchboard, 400 subscribers' telephones and 400 protectors.

MELBOURNE, VICTORIA.—January 21st. The Postmaster-General requires tenders for 250 visual vibrating indicators.

MELBOURNE.—May 26th. The Postmaster-General invites tenders for a common battery switchboard, together with all associated frames, racks, power plant and parts and apparatus for consumers as follows:—3,000 telephone wall sets; 200 ditto for party lines; 100 ditto; 150 extension switches complete; 10 switchboards, two and six lines; 50 ditto, three and 10 lines; 10 ditto, six and 20 lines; 10 ditto, eight and 50 lines.

Austria.—The municipal authorities are about to invite tenders for the establishment of a central electric lighting station in the town of Nikolsdorf, near Linz.

Austria.—The municipal authorities of Klagenfurt are about to invite tenders for the extension of the central electric light station, at an estimated cost of 500,000 crowns.

Belgium.—February 1st. The municipal authorities of Ghent are inviting tenders for the supply of 30 electric cranes, and the erection of the same along the new dock. Particulars may be obtained from, and tenders are to be sent to, L'Hotel de Ville, Ghent.

Belgium.—Tenders have just been invited by the municipal authorities of Engis (Liége) for the establishment of a central generating station in the town for the supply of electrical energy for public and private electric lighting and power purposes.

Belgium.—The municipal authorities of Chokier (Liége) have just invited tenders for the establishment of a central electricity station in the town.

Finchley.—January 20th. One 350-KW. high-speed engine and dynamo, &c., for the Council's electricity works. See "Official Notices" December 20th.

France.—January 15th. The municipal authorities of Lyons are inviting projects for the establishment of a combination refuse destructor and electric power generating station.

Germany.—The municipal authorities of Geestemunde are about to invite tenders for the extension of the central electric lighting station, at an estimated cost of £12,850.

Germany.—The municipal authorities of Lassau (Pomerania) are about to invite tenders for the establishment of a central electric lighting station in the town.

Glasgow.—January 14th. Turbo-alternators of 4,000 KW. output. See "Official Notices" to-day.

Halifax.—The Tramways Committee has decided to purchase an impregnator and dryer for armatures, at an estimated cost of £120, also a fire turning lathe, at an estimated cost of £150.

Kilkenny.—January 18th. Suction gas plants, gas engines, electric generators, battery, switchboard, mains, wiring, &c., for the District Lunatic Asylum. See "Official Notices" December 20th.

London.—January 8th. The Metropolitan Asylums Board invite tenders for an electric lighting installation in the motor workshops and yard at a Fulham ambulance station. See "Official Notices" December 20th.

Manchester.—January 14th and 20th. The Tramways Committee requires tenders for various machine tools by January 14th, and for mackintoshes, leggings and sou'-westers by January 20th. Particulars may be obtained from the General Manager, 55, Piccadilly.

Manila.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Paris.—January 10th. The Post and Telegraph department requires tenders for galvanised iron wire of 1, 4 and 5 mm. diameter. Tenders to Under-Secretary, 103, Rue de Grenelle.

Paris.—January 14th. The Colonial Office requires tenders for galvanised insulator supports. Tenders to Directeur, 3, Rue Flydeau.

Plymouth.—January 23rd. Stores for the Corporation Electricity Department. See "Official Notices" to-day.

Rochdale.—The T.C. invites tenders for one 50-KW. three-phase transformer. C. C. Atchison, electrical engineer, Dane Street, Rochdale.

Rome.—January 15th. The Administration of the Italian Government Railways requires tenders for the supply of arc lamp carbons.

Spain.—ARAUJUEZ.—January 14th. The municipal authorities require tenders for public lighting (210 lamps, of 32 C.P. each) for six years. Tenders to Ayuntamiento Constitutional.

Spain.—January 11th and 12th. The municipal authorities of Madrid require tenders for the construction, &c., of electric tramways in Madrid, from the Placa de los Ministerios, through the following streets, Encarnacion, Arrieta, Arenal, Puerta del Sol, Alcalá, Paseo del Prado, Juan de Mena, Alarcon, Felipe IV, Moreto, Espalter, to Alfonso XII. Particulars may be obtained from the Ayuntamiento Constitutional. Tenders by January 11th.

The Public Works Department of Madrid require tenders, &c., for the construction of electric tramways in Valencia, by January 12th.

Spain.—MADRID.—January 16th. The Post and Telegraph department requires tenders for installation of telephone system at La Garrige (province of Barcelona). Tenders to Direccion General de Correos y Telegrafos, Carretas, 13.

Spain.—Tenders have just been invited by the municipal authorities of Villalba (province of Lugo) for the concession for the electric lighting of the town during a period of 20 years.

Spain.—The municipal authorities of Monforte (province of Lugo) have just invited tenders for the concession for the electric lighting of the town during a period of 30 years.

Spain.—The Spanish Post and Telegraph authorities in Madrid have lately invited tenders for the concession for the construction and working of a telephone system in the south-eastern district of Spain.

Tyrol.—The municipal authorities of Partschins (Tyrol), are about to invite tenders for the establishment of a central generating station in the town for the supply of electrical energy for lighting and power purposes.

Wimbledon.—Tenders are to be invited for the supply and installation of a 1,000-KW. turbo-alternator with condenser, and two water-tube boilers with economisers, pipe-work, feed pumps, &c., also a remote control H.T. switchboard for the Council's power station. Tenders are also to be asked for the year's supply of flame arc carbons, from March 31st next.

CLOSED.

Bahamas.—The *Standard* published a "Central News" despatch, according to which the Governor of the Bahamas has intimated that the contract for building and equipping the municipal electric lighting plant for Nassau will be given to an American firm. The specifications were drawn up in London, and the value of the contract is about £16,000.

(*Continued on page* 23.)

CANAL EXCAVATION BY ELECTRIC POWER.

By DUDLEY W. WALTON, New York.

ELECTRICITY is being used as the sole motive power for the excavation of a three-mile section of the canal between New York and Buffalo, now under construction by the State of New York, the governing authorities of which voted a sum of £21,000,000 for this purpose about two years ago, as a result of a direct appeal to the people by means of a referendum vote.

Mr. F. A. Masselli is the contractor for this particular three-mile section, which begins near the city of Rochester, N.Y., and he spent a whole year in preparation before drilling a single hole in the enormous mass of solid rock which he has to remove. The cross-section of the canal is 120 ft. in width at the top, tapering down to 94 ft. at the bottom, with an average depth of 34 ft. The preliminary work consisted in the erection of a gigantic bridge-like structure 438 ft. in length from end to end and 95 ft. in height from the trucks which support the base to the top member. This immense structure is known as the Hoover and Mason "grab," and was originally designed by Mr. Arthur J. Mason, of Chicago, for the purpose of handling mineral ore. It was erected at Rochester by Mr. Otis O. Ogden, also of Chicago. As used on the canal work, it is estimated to save the labour of 1,000 men. The steel work, its erection, and the necessary equipment cost £33,500.

Fig. 1 shows the "grab" in position across a portion of the excavation at the town of Gates, near Rochester. The supports of this huge travelling crane are on wheels which run along parallel tracks on either side of the route of the canal, and adjacent to these are various lines of railway for the conveyance of the *débris* of the excavation. A travelling trolley cabin, suspended from above, runs the whole length of the structure. This cabin accommodates two men, who, by means of levers, control sundry electric motors, and the entire operation, not only of the hoisting and dumping machinery, but also of the forward movement of the structure itself. The grab is propelled forward by means of four 25-H.P. electric motors, which operate capstans around which are wound 1½ in. steel cables. The trolley is moved backwards and forwards by means of two 60-H.P. motors. The hoisting mechanism, as will be seen in fig. 2, comprises two enormous jaws, about 20 ft. in length. These jaws, which are operated in the same manner as those of smaller hoists, pick up 12 tons of broken rock at a time, and dump it into railway trucks on the right or left bank of the canal, as may be convenient. The four motors used for the main hoist are of 80-H.P. each. The operation of picking up a load, depositing it and returning, can be accomplished in a little more than one minute, and during a working day of 20 hours, as much as 12,000 tons of rock have been removed, representing an advance of 50 ft. per diem. These figures, however, do not represent an average day's progress. The structure is illuminated by arc lamps when needed.

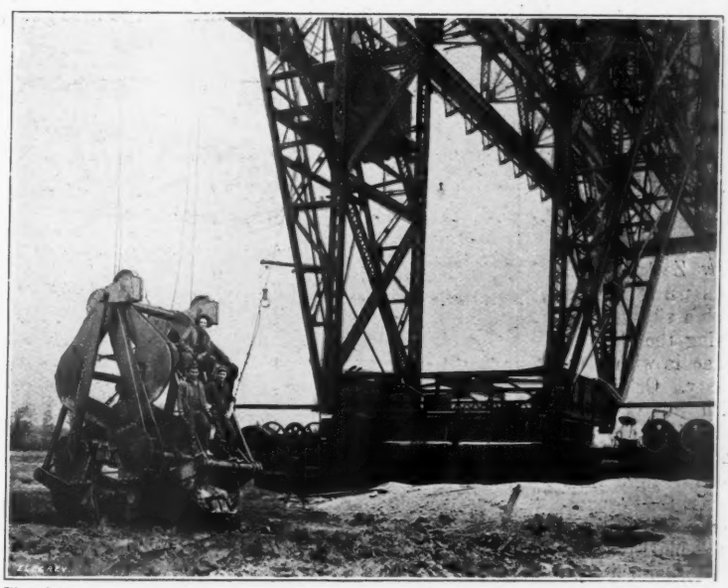


Photo by] [*W. Hinshelwood.*

FIG. 1.—12-TON ELECTRICALLY-OPERATED LIFTING JAWS, HOOVER & MASON GRAB.

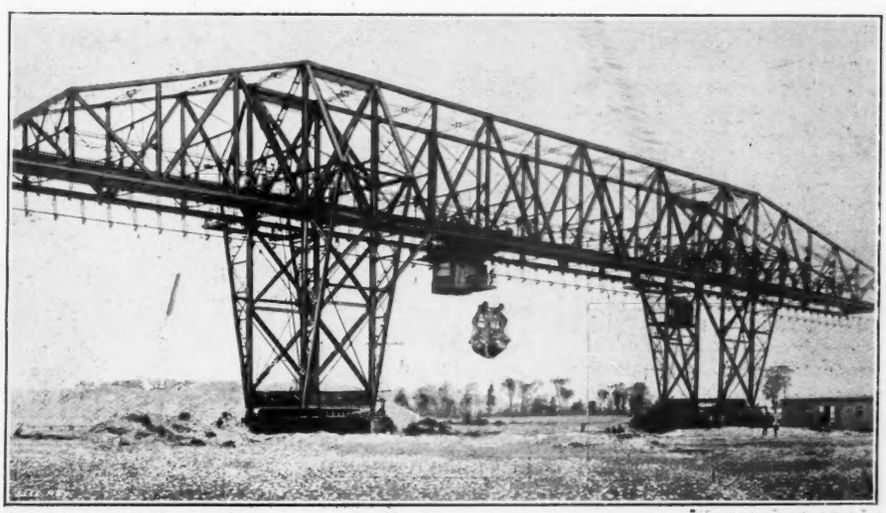


Photo by] [*W. Hinshelwood.*

FIG. 2.—THE HOOVER & MASON GRAB AS EMPLOYED IN CANAL WORK, AT ROCHESTER, U.S.A.

The rock is prepared for the excavator by drills, which are worked by compressed air, steam drilling having been discarded. Power from the same transformers which operate the trolley, is brought by cable into the bed of the canal to drive the air compressors, and this method of drilling, and the diamond-tipped tools employed, will penetrate 100 in. in the same time that 65 in. can be cut by steam drills. Four holes are drilled at one time. When the weather is dry, 350 lb. of black gunpowder is placed in each hole; in wet weather 70 lb. of dynamite is used instead of powder. The simultaneous explosion, by means of electric fuses, of the four charges has been known to loosen as much as 1,300 tons of rock, which can then be carried away by the grab without further treatment.

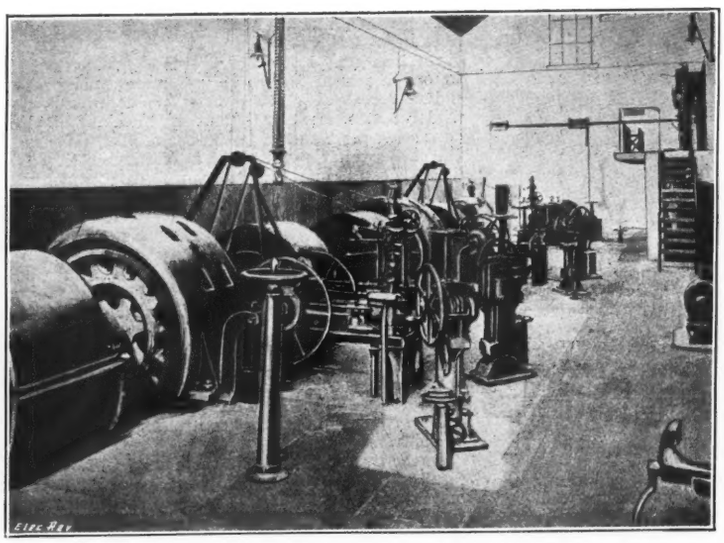
Power is supplied for the motors by the Rochester Railway and Light Co.; alternating-current delivered at 4,100 volts, being stepped down and transformed to 140 volts direct-current.

F

THE WAIPORI HYDRO-ELECTRIC PLANT, NEW ZEALAND.

From time to time we have referred at length to the great future of New Zealand, in the matter of hydro-electric development, which, according to the report of the late Mr. P. S. Hay, of the New Zealand Public Works Department, was equivalent to a possible 3,700,000 H.P., after making due allowance for all loss of head in pipes, &c., and for the loss in conversion to electricity.

The Waipori scheme is the first important development of its kind in New Zealand, and was undertaken with a view to supplying the City of Dunedin with electricity. Originally, with a view to supplying the city and suburbs with electric light and power, the Corporation embarked on a scheme to utilise a site on the Lee River, some 12 miles from the city, giving a head of 700 ft.



The Generating Plant, Waipori Power Station.

This scheme involved the construction of a tunnel 1½ miles long, which was actually completed for some two-thirds of its length, before the scheme was abandoned with a view to purchasing the Waipori Co.'s undertaking. The latter company was formed in 1902, and applied to Parliament for powers to compete in the supply of electricity in Dunedin and district, but the Corporation of Dunedin realising that its powers would be jeopardised by such a proceeding, brought out the rights of the company in October, 1904, for some £12,500, abandoning its Lee River scheme, on which some £18,000 had been spent. As the proposals of the Corporation were much more comprehensive than those of the company, the scheme was materially amplified with a view to ensuring permanent operation and eliminating all risk of stoppage.

The Waipori River rises in the Lammerlaw Mountains, which rise 4,000 to 6,000 ft. above sea level—the site of the intake works being some 1,125 ft. above the sea. From this point the river drops some 700 ft. in less than 2 miles to the power station.

The intake works consist of a rock-filled crib-work weir, 76 ft. long and 15 ft. deep, stretching across the river; from one side of this a short tunnel, cut through rock, leads to the flume, which is controlled by two head gates, each 4 ft. sq., operated by hand gearing.

The conduit for the water embraces earthworks, tunnels and pipes, with a total length of about 2¼ miles.

From the intake rectangular wooden fluming, 6 ft. × 4 ft. deep, with a uniform fall of 8 ft. to the mile, and some 136 ch. long, also six tunnels of 11 ch. length, lead to the penstock; four spillways are provided in the distance, also two catchment basins to intercept stones. The flume was constructed of birch with pitched joints; the birch was obtained locally, and a saw mill operated by water power, was erected for cutting it. A 3,000 ft. cable tramway and four miles of wooden tramway were also constructed for hauling the logs to the mill and on to the site.

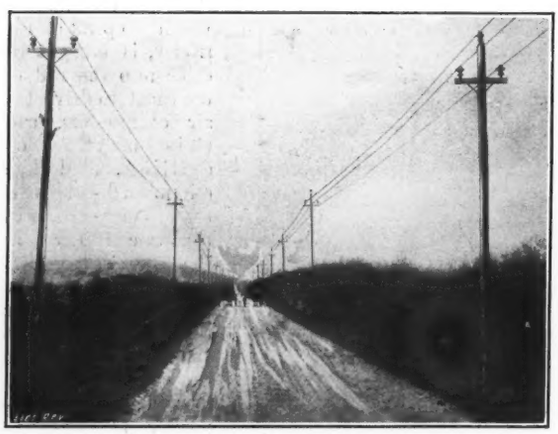
The tunnels vary from 20 to 295 ft. long and are of slightly larger section than the flume.

The penstock is of concrete, 13 ft. long, 9 ft. wide and 10 ft. deep below the sill of the flume; sufficient velocity being obtained in the falling water to compensate for the head loss in the pipe entrance.

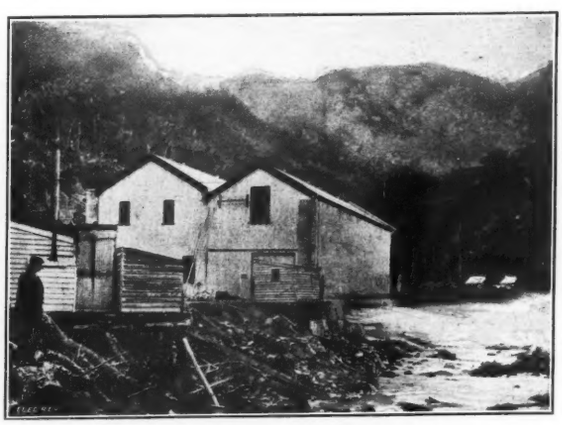
Two straining grids are provided in the end of the flume, one of inclined bars and the other of galvanised wire netting. Two steel pipes, varying in diameter from 42 in. at the top to 36 in. at the bottom, some 1,776 ft. distant, lead to the power house.

The pipes are of riveted steel, varying in thickness from ⅛ in. to ½ in., and in 20 ft. lengths; they were jointed and hand riveted in trenches and afterwards covered with soil to a depth of some 2 ft. 6 in., as a protection against temperature changes.

Six anchorages and five air valves are provided in the



Main Transmission Lines on Public Road.



Exterior of the Power House.

pipe line which passes at its lower end through a short tunnel, at the extremity of which the 36-in. dia. pipe divides into four 14-in. dia. branches, each leading to the nozzle of an impulse wheel.

A 6-in. branch is provided for the exciter units, and a 4-in. branch leads to an air receiver, 30 ft. long × 36 in. dia. The latter is to provide against shock due to water hammer, and the air pressure is maintained equal to the pressure in the pipe line by a motor-operated compressor, controlled automatically through a float in the receiver.

The weight of the column of water in the pipes is about 470 tons, which at full bore moves with a velocity of 5·6 ft. per second.

As the main water supply contains a good deal of mud, a supply of clear water with a head of 400 ft., obtained from a creek in the vicinity, was utilised for the governors, transformer cooling, &c.

The power station is a reinforced concrete structure, 100 ft. long and 64 ft. wide, situated on the bank of the river; one bay contains the hydro-electric plant and the other the switch and transformer gear.

At present two generating units are installed, each consisting of a G.E. (U.S.A.) 1,000-KW., 2,400-volt 50-cycle generator driven by two Pelton wheels, mounted at either side.

The generators are of the three-phase revolving field type—each field having 14 poles, and run at 429 R.P.M. The regulation at full load and 1·0 P.F. is 7 per cent., and with 1,000 K.V.A. and ·75 P.F. is 15 per cent., the efficiency being 95 per cent. at full load.

The Pelton wheels are each 4 ft. 6 in. dia., and fitted with 25 buckets; the water flow is in practice controlled by the needle nozzles which are operated by worm gear and hand wheels.

The nozzles are deflected off the buckets by means of hydraulic governors of the Lombard type, the water jet passing clear of the buckets at no-load and striking a deflector plate.

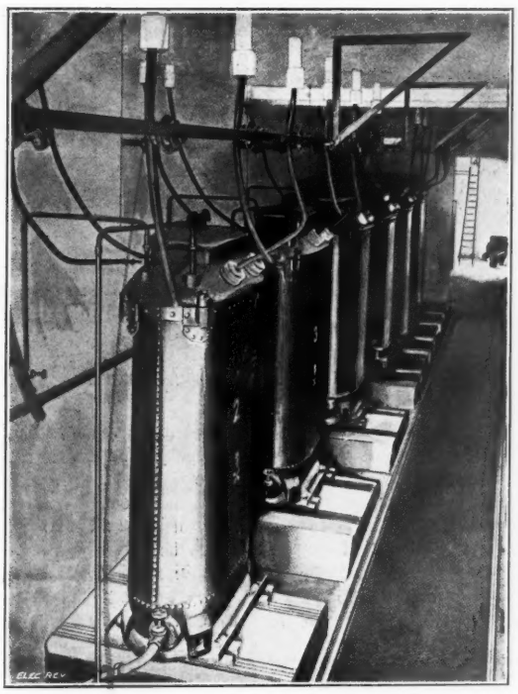
These governors are provided with electric control from the switchboard and regulate to within 4 per cent. from no-load to full-load.

The Pelton wheels are capable of driving the generators at 50 per cent. overload, and have shown an efficiency of 83 per cent. at full load. An efficiency test showed that with 29 cb. ft. of water per second, the total theoretical horse-power at the power house was 2,185; the spouting velocity at the nozzles, 12,360 ft. per min., and the peripheral speed of the wheels, 5,945 ft. per min.

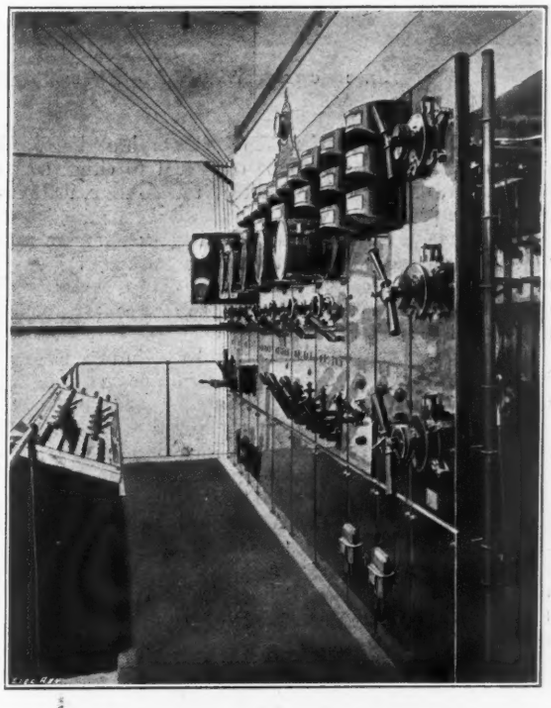
Two exciter units, each consisting of a 40-KW. direct-current 125-volt generator coupled to one side of a 60-H.P. Pelton wheel, and with a 60-H.P. induction motor coupled to the other side of the wheel, are installed at one end of the power house.

The induction motor is arranged to act as a regulator for the exciter, the position of the needle nozzles being fixed to take care of the normal load on the exciter.

On the ground floor of the bay adjoining the engine room are situated corridors containing H.T. and L.T. bus-bars, with a transformer room in between. The dividing walls are of concrete, and support a switch room above, containing H. and L.T. remote-control oil switches. The switch operating gallery faces on to the engine room, and is equipped with four generator panels, two exciter panels, motor, transformer and regulating, and two line panels; also with a desk board containing the auxiliary control switches for the oil switch and governor gear. The whole of this gear was supplied by the G.E.Co. (U.S.A.)



VIEW OF THE STEP-UP TRANSFORMERS, WAIPORI.



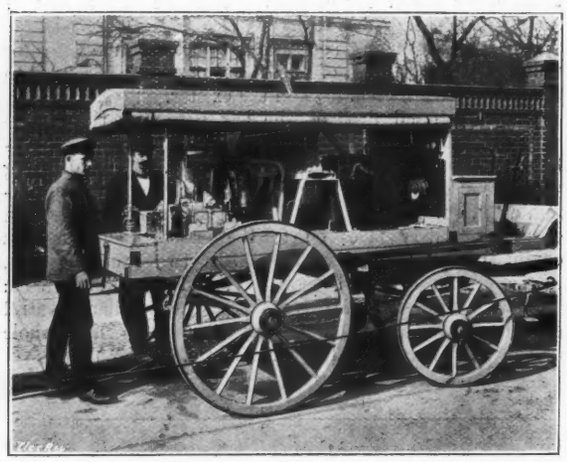
THE MAIN SWITCHBOARD AND CONTROL DESK.

The circuits pass from the switchboard bus-bars through hand-operated oil switches on the board to the L.T. (2,400-volt) bars in the corridor, and on to four Westinghouse solenoid operated switches which connect to the L.T. side of the transformers. The latter are seven in number, of the G.E.Co.'s oil insulated, water-cooled type, each having a rated capacity of 350 KW., and arranged in two banks of three each, with one to spare. The step-up ratio is 2,400/20,000; the transformers are mesh connected on the L.T. and star connected on the H.T. side, with the neutral earthed, giving 34,700 volts between phases. The primary full load current is 146 amperes, and the secondary full load current 17·5 amperes; each transformer is 11 ft. high, weighing 5½ tons, and is mounted on a small trolley which can be moved on to a bogie and wheeled into the engine room for dissembling under the 15-ton traveller there provided.

The H.T. side of the transformers is connected to the H.T. bus-bars through four G.E. motor-operated oil switches; these bus-bars are coupled to the 35,000-volt "line" bars through other four Westinghouse solenoid oil switches, and two further G.E. motor-operated switches control the two outgoing transmission lines. The oil switches are all placed

in concrete cubicles, and have disconnecting switches on either side.

The station control circuits for motors, solenoids, signal lights, &c., are energised from the exciter units.



Electrically-driven Portable Cable Winch: Views of the Petrol-electric Power Plant.

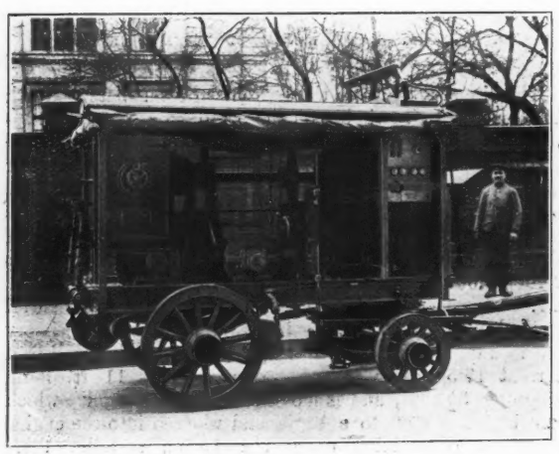
The wiring of the station is in duplicate throughout, and permits either generator to be connected to either transmission line, through either bank of transformers, independently or in parallel.

Six standard Westinghouse lightning arresters are provided, one to each phase of the two transmission lines, and oil-insulated choke coils are connected between the arresters and line switches to safeguard the transformers from dangerous line surges.

The first transmission of energy to Dunedin took place in March, 1907, and permanent operation commenced in the following month.

The transmission lines from the power station, run to a sub-station at Halfway Bush, and from the latter to a converter station in the city, covering some 30 miles of route.

The two lines are spaced some 30 ft. apart as a minimum, the wires being mounted on Australian hardwood posts with ironwork cross-arms carrying the insulators. The lines cross rivers, railways, and i some cases, private property, and in these situations some 15 steel towers have been used; one line of posts also carries the telephone line between Waipori and Dunedin.



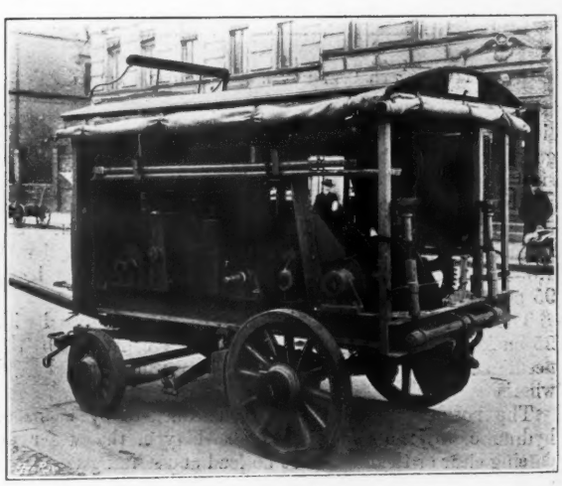
The contractors for the whole of the work, Messrs. Noyes Bros., Sydney, estimated the total cost of the scheme, including hydraulic work, purchase money, &c., at £210,000 for the 2,000-kw. installation, including power station capacity for 3,000 kw., sub-station capacity for 6,000 kw., and H.T. transmission line capacity for 4,000 kw. The estimate includes £75,000 for the mains extensions in the city, which are being carried out on the underground system.

In conclusion, we may say that Mr. W. T. Goodman, A.M.I.E.E., acted as chief engineer during the carrying out of the above scheme.

AN ELECTRICALLY-DRIVEN PORTABLE CABLE WINCH.

By Our German Correspondent.

The German Telegraph Department have been using for some time past portable hand winches for drawing telegraph cables into pipes or cement conduits. These winches consist mainly of a substantially-built frame carrying a drum, rotated through a toothed wheel pinion and two intermediary gearings. In order to make the operation of these cable winches more convenient and economical, an attempt has just been made to work them by some mechanical means. As such winches have to be frequently transported from one street or square to the other, the source of energy used in their operation had to be readily transportable and available at a moment's notice. These conditions were complied with by benzine or alcohol



Two Views of the Portable Electrically-driven Cable Winch.

motors, but the power generated by such motors cannot be transmitted immediately to the cable winch, owing to the fact that the operation of the motor cannot be altered within very wide limits, as, for instance, in the case of steam engines, by throttling, &c. Now speed control was quite indispensable in the present case, the speed of laying the cable having to be adapted to the local conditions. A suitable connection between the motor and winch had, therefore, to be chosen in order to allow the former to continue working, while altering the motion of the winch quite smoothly and without any stoppage. The friction clutches or two-cylinder clutches used in the case of automobiles were not reliable enough in the present case, owing to the very considerable pull (up to 3,000 kg.) unless prohibitive dimensions were chosen. Though a conversion of energy, owing to the unavoidable losses, was not very desirable, the addition of an electric set consisting of a direct-current dynamo and an electric motor was considered as the most satisfactory solution of the problem, the operation of the winch being then controlled rapidly and safely by altering the resistance in the electric circuit.

The accompanying views represent the electrically-driven cable winch constructed on the above lines by the Siemens and Halske Co, which has been recently put into operation. In order to make the plant as elastic as possible, allowing the benzine motor to be used also for other purposes, the explosion motor and dynamo on the one hand, and the electro-motor and winch proper on the other were mounted on special carts. The plant therefore comprises :—

1. The power wagon (figs. 1 and 2, p. 22), in which the wrought-iron frame of the cart rests by means of springs on two axles with wooden wheels. The cart is fitted with a hand brake operated from the driver's seat, and is protected against rain and dust by zinc sheet roofing. A two-cylinder benzine motor, yielding 6 H.P. at 650 R.P.M., is located above the rear axle, the benzine consumption being about ·5 litre per effective H.P.-hour. The motor is controlled by an adjusting lever fitted on the carburetter ; both the motor and carburetter are entirely enclosed, so as to be protected against atmospheric influences. The hood and cylinder are of bronze, thus preventing any rusting or corrosion. Cooling is effected by a fixed amount of water, which is cooled over again in an injection apparatus, the draught necessary for the latter being produced by a fan. The exhaust gases pass through a silencing device.

A direct-current shunt dynamo giving about 3·5 KW. at 650 R.P.M., coupled directly to the driving motor through a flexible clutch. A belt pulley, which can be used for driving any kind of machine, such as, for instance, a pump, has been provided on the motor shaft. A small marble switchboard contains a double-pole fuse and double-pole switch, in addition to a voltmeter and ammeter suspended by springs. The cart further carries a cable drum with contact plug serving to receive 50 m. rubber-insulated double cable connecting the dynamo with the motor situated on the winch.

2. The cable winch (figs. 3 and 4) which, with its electric motor, is likewise fitted on a cart with wrought-iron frame. The rear wheels of this cart are provided with a hand brake, in addition to which two props have been provided to allow the cart to be steadied when in use. The roof is designed similarly to that of the power cart, and carries the driver's seat.

A continuous-current motor, yielding about 3 H.P., with 220 volts, at 1,200 R.P.M., and with an efficiency of 80 per cent., is used to operate the winch ; the speed is controlled by means of a starting regulating resistance in 13 stages, which allows the winch to be started at a very low speed.

The regulating resistance is fixed to, but insulated from, an iron plate riveted to two angle irons. A small marble switchboard (containing a contact box, a double-pole switch and two fuses for an incandescent lamp circuit) is fitted to the same plate. The winch is driven through an enclosed worm-gear fitted in an oil case and gearing, the shaft of the worm wheel being connected to the winding gear through a clutch, which can be released for operating the winding gear by hand.

The gearing allows, at normal speed and full torque of the motor, a rope speed of 2 m. per minute, with a tension of 2,000 kg., 4 m. with a tension of 1,000 kg., or 6 m. with 500 kg. to be reached. Furthermore, by regulating the number of turns of the motor, these three speeds of the rope can be altered in the ratio of 1 : 10, so that a total range of 1 : 40 is available in the speed of the rope, corresponding to a variation of from ·2 to 8 m. per minute.

The steel wire rope has a breaking strength of 10,900 kg. with a diameter of 12·5 mm. Another rope, 10 mm. in diameter, of a breaking strength of 5,000 kg., which is more easily handled, can be used in connection with lighter cables.

The rope is wound uniformly by an automatic guiding device on to the rope drum, which has a capacity for about 300 m. The drum shaft is provided with a friction drive imparting to the rope sufficient tension to prevent its sliding in the winch drum. The friction gear is driven through a chain from a shaft of the winch drum. A dynamometer, to which the tension of the rope is transmitted with the aid of two rollers and a lever, allows the actual tension to be gauged at any moment, the dynamometer being adjusted to any maximum tension (up to 1,000 kg.). As soon as the tension adjusted for has been reached, a cutout is actuated so as to break the motor current, while a mechanical brake at the same time prevents the winch from operating.

In order to remove the rope from the drum, the clutches of the rope and winch drums are opened so as to cause both drums to run loosely on their shafts.

The plant above described has given much satisfaction in operation, and has enabled a considerable saving to be effected.

The writer is indebted for much of the information contained in the above article to Mr. Hermann Schultz, German Telegraph Inspector.

CONTRACTS CLOSED.

(*Continued from page* 18.)

Belgium.—The Compagnie d'Electricité de Seraing et Extensions submitted the lowest tender to the municipal authorities of Jemeppe-sur-Meuse (Liége) for the supply of electrical energy for public and private electric lighting and power purposes. The price quoted is on the basis of 20 centimes (2d.) per KW.-hour for public lighting.

Bradford.—The Bradford Electrical Engineering Co., Ltd., has secured the contracts for an electric light and power installation and switchboard for Messrs. Harrison's extensive printing works, and an electric light installation, fittings, bells, &c., for Mr. Oates Ingham, The Mount, Peel Park, Bradford.

Cleckheaton.—The U.D.C. has accepted the tender of Messrs. G. Hood & Co. for the supply of electrical fittings, &c., for the Turkish baths.

Erith.—The U.D.C. has accepted the tender of the Woodville Electric Co. for the wiring of 48 municipal cottages in Brook Street, at £168.

Glasgow.—The Corporation Tramways Committee has accepted the following offers :—

British Thomson-Houston Co.—Finger arc shields for controllers.
British Insulated & Helsby Cables, Ltd.—Extra-high-tension rubber cables.
Siemens Bros.—7/18 and 7/22 lighting cables.

Lancaster.—The T.C. has accepted the tender of Mr. R. P. Wilson for wiring in metal tubing and fixing electric lights at the Storey Institute, at £240, and for fixing electric bells, at £18.

South Wales.—The Treforest Electrical Consumers Co., Ltd., having decided to extend its plant, has placed an order with the British Westinghouse Electric & Manufacturing Co., Ltd., for one 3,000-KW. turbo-generator, 1,500 R.P.M., and complete high-vacuum surface-condensing plant, fitted with the Westinghouse-Leblanc dry air pump.

Stoke-on-Trent.—The T.C. has accepted the tender of the Phœnix Dynamo Co. for the supply of a balancer and booster, at £267 10s., and that of the Switchgear Co. for switching apparatus, at £98 17s. 6d.

West Bromwich.—The T.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for the supply of cables.

FORTHCOMING EVENTS.

Tuesday, January 7th.—At 7.30 p.m. At the University, Manchester. Institution of Electrical Engineers (Manchester Section). Paper on "Magnetic Oscillations in Alternators," by Mr. G. W. Worrall.

Wednesday, January 8th.—At 8 p.m. At Society of Arts, John Street, Adelphi. Junior Institution of Engineers. Paper on "Recent Improvements in Electric Conduit Traction Construction," by Mr. Fitz Roy Roose.

At 8 p.m. Association of Engineers-in-Charge. "Electrical Measuring Instruments, and Some of their Weaknesses," by Mr. Kenelm Edgcumbe.

Thursday, January 9th.—At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. Paper on "Cost of Electrical Power for Industrial Purposes," by Mr. J. F. C. Snell.

Friday, January 10th.—At 8 p.m. At the King's Hall, Holborn Restaurant. Smoking concert of the Electro-Harmonic Society.

Saturday, January 11th.—At 3 p.m. Junior Institution of Engineers. Visit to the L.C.C. tramway reconstruction work in South Lambeth Road, and motor school: car-shed and sub-station at Clapham.

NOTES.

Memorial to Lord Kelvin.—Sir Otto Jaffe, president of the Belfast Natural History and Philosophical Society, has taken preliminary steps to form a committee to honour the memory of Lord Kelvin by erecting a statue or other suitable memorial in Belfast. That city, as his lordship's birthplace, has of course a just local claim, and we have no desire whatever to belittle efforts of such a kind to do lasting honour to the great scientist's memory, for he was worthy of all of them. We should, however, like to suggest that a movement be at once set on foot for establishing a truly representative international memorial to be erected, or have place, in one of the two great centres where his lordship was most frequently engaged in the pursuits of science—London or Glasgow. A committee of the Institution of Electrical Engineers, or a joint committee of representatives of all the scientific institutions, from the Royal Society down to the lowliest of societies in which he had an interest, should be appointed. We are confident that from many foreign countries there would be a most ready and generous response if there were no delay in taking the matter in hand. In the highest, as also in the lowest, circles Lord Kelvin's death continues to call forth expressions of regret, coupled with admiration for his marvellous achievements. On New Year's Day, King Victor Emmanuel made special references of this kind at his Reception of Senators and Ministers, &c.

The will of the late Lord Kelvin is dated December 8th, 1905. His whole means and estate, including his property of Netherhall, Largs, and his house in London, pass to his widow, Lady Kelvin, absolutely. According to the *Morning Post*, the will contains a number of provisions, which are, with one exception, entirely of a private family nature, the exception being a legacy of £5,000 to the University of Glasgow, which is to be applied by the Senate of the University for promoting research and teaching in physical science in connection with natural philosophy, of which Lord Kelvin was so long professor at the University. The executors are Lady Kelvin, his Lordship's nephew and grand-nephew, Dr. J. T. Bottomley, of Glasgow, and Dr. J. Frank Bottomley, of Newcastle-on-Tyne, and his solicitor, Mr. Timothy Warren, Glasgow. Lord Kelvin's total estate has not yet been lodged, but it is stated to be under one million sterling.

Educational Notes.—FARADAY HOUSE SCHOLARSHIPS.—As the result of recent examinations, an exhibition of 25 guineas, tenable for two years, has been awarded to Bertie T. Altson, of Bedford Grammar School, and one of 20 guineas for two years to J. H. Shannon, Royal School, Dungannon.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—The certificates gained during the winter term were presented on December 20th by Mr. T. H. Riches, president of the Institution of Mechanical Engineers.

Manufacturing Practicalities.—It has been stated by a writer on system in design and manufacture that there are many practical points overlooked by German designers, who are not as well acquainted as they should be with the possibilities and capacities of the tools in the shops, and are apparently not limited to custom standards and dimensions. Thus the German draughtsman may put in a $\frac{9}{16}$ bolt when such a size should not be included in the shop stores, and a more practical man would use one of $\frac{1}{2}$ in. or a $\frac{5}{8}$ size. He also draws in parabolic curves where he ought to know that the piece will be finished by a circular milling cutter, to the advantage of cheapness, if considerably to the detriment of appearance. The German designer also appears to neglect accessibility of parts, and he would feel it to be rank heresy to employ the same connecting rod for a vertical and for a horizontal engine of the same size. He has, in fact, not sufficiently grasped the proper connection of technical and practical knowledge. This does not, perhaps, prove that he never will do so, and probably the picture has been overdrawn in some respects, so that it resembles rather a slight caricature than a good photographic view. Here in Great Britain we are too apt to rely solely upon our practical aptitude, to the neglect of technical teachings, and this leads to deficiencies that would be avoided by men of better scientific knowledge. Here we are all apt to be merely practical. In Germany there are more technical heads, but they are too aloof from the practical men, and it is said that a German draughtsman rarely follows his work into the shop. He does not care to do so, and did he care he would not be allowed to do so.

Some works carry specialising too far. Lines of tools only used, it may be, every two or three years, are kept together to save the expense of putting them together when another batch of castings is called for. In this way a wealth of cutter spindles, cutters, drills, &c., is in stock at heavy interest merely that they may be used a few times every few years. Such a policy may easily be carried too far. It brings a very heavy burden upon a works which makes too wide a variety of things, and yet tries to specialise as far into every minute detail as though but one machine absorbed all the shop's energies. Both attitudes are wrong where too rigidly adhered to. A well-known Manchester man not long ago told a meeting of Manchester "engineers" that there was a time when Manchester led the world in engineering, and Manchester men were engineers, whereas to-day they were nothing but manufacturers. This is the antithesis of the German attitude, and equally to be avoided.

New Electrical Schemes to come before Parliament.—The following additions have been made to the list of applications before Parliament, detailed in our issue of December 9th last:—

BARRHEAD.—Electric lighting order for the Strathclyde Electricity Supply Co., Ltd.

BISPHAM-WITH-NORBRECK.—Electric lighting order by the U.D.C.

CARMARTHEN.—Electric lighting order by J. B. Saunders & Co., for the county borough.

CLYDEBANK.—Amendment to electric lighting order by Clyde Valley Electrical Power Co.

DUNDEE.—Extension of order by Dundee Gas Commissioners.

JOHNSTONE.—Electric lighting order by Strathclyde Electricity Supply Co., Ltd.

RUTHERGLEN.—Amendment of order by Corporation.

School-Room Lighting.—The annual report of the Medical Officer (Education) of the London County Council (Dr. James Kerr), which has just been issued, contains some important remarks with regard to the artificial lighting of school rooms. It states that Mr. Bishop Harman undertook an inquiry and had furnished some valuable information as to the best positions of the sources of light and the best distribution of light, and what simple improvements could be suggested. His experimental observations were made in school rooms and in his own laboratory. Handiness, simplicity and ease of distributing points of light, complete absence of shadows below the lamp, the possibility of perfect reflection, healthiness in freedom from consumption of air and production of fumes, and noiselessness, make lighting by the electric glow lamp the most perfect means now available for school use, the only drawback being its present greater cost, which worked out for the last 12 months for which figures were available at about 1·7 times that of gas. The following experimental examination of the illumination given by a glow lamp under different shades will give an indication of the value of the light. A 16-C.P. lamp was used, fed at 100 volts from the Strand supply. The lamp was hanging in a room chosen for its convenience, and the C.P. measurements were made in a plane 4 ft. below the level of the lamp:—Shade, none, (1) below lamp, 5; (2) 1 yard, 3; (3) 2 yards, 1; (4) 3 yards, 1; (5) 4 yards, 1; shade, 110°, 3½ in. deep, (1) 20, (2) 9, (3) 5, (4) 3, (5) 1; shade, 80°, 5 in. deep, (1) 30, (2) 9, (3) 5, (4) 2, (5) 1.

Two sorts of opal shades are in use in the schools; one subtends a cone of 110°, and has a vertical depth of 3 in. This shade does not cover the lamp, and the incandescent filament is exposed to the teacher's eyes. The other shade has sides subtending an angle of 80°, with a vertical depth of 5 in.; this shade completely screens the lamp from the teacher, and is the one to be preferred for classroom purposes as the light below is also increased by one-third. These lamps throw an image of the filament. The better the reflector over the lamp, the less noticeable are these lines. Ground glass bulbs obscure the lines completely, but frosting the glass reduces the illumination by 25 to 30 per cent. The only suggestion to be made as to bulbs is that these should be as large as possible, with the filament twisted in as long a loop as possible. Mr. Harman has also examined the "Tantalum" and the "Nernst" lamps. The former appears very good, but the latter is unsuitable for schoolrooms. With regard to the distribution of the lamps, beginning at the left hand of the children's portion of the classroom, a lamp should be hung over the centre of the first dual desk, and from there across the breadth of the room at distances of not less than 6 ft. and not more than 9 ft. for 16-C.P. lamps with 90° shades. With gas, the smallest possible number of burners is desirable, for the more burners the worse the atmosphere; but with electricity the points of light may with advantage be more generously disposed, and a cross-room spacing of 6 ft. might be uniformly arranged. A second row of lamps should be hung in the same relation over the third row of desks. The lamps, as usually hung, err in being hung too far back; for instance, over a back row of desks, with the idea of their illuminating the desks in front, which they, however, fail to do when the children are present in their seats. The use of a front row of lamps, with tilting shades to light the blackboard in the teachers' section of the room, or desks in the children's portion, fails to serve both purposes in practice. It would be better to use a lamp to illuminate the desk and blackboard and completely shaded from the children's portion of the room. The most common complaint in electrically-lighted schools is want of light, owing to low pressure in the supply. Sudden and total failure also occurs occasionally. In installing electric light, it should be used in classrooms only. Staircases and passages should be lighted with gas, naked jets with wire frames. In one old school building where

communication was from classroom to classroom, and where passages had irregular floor surfaces, the evening classes were much attended by foreigners, and, in the event of failure of light, the difficulties of exit would probably have puzzled even the schoolkeeper. In addition to these ordinary means of illumination used in the schools, there are several other methods used in America or on the Continent. The inverted incandescence gas burners, recently much used in shop lighting, although they throw the light downwards, have drawbacks for school use. With an inverted Bunsen burner, the combustion is imperfect, and noxious fumes escape to a much greater extent than with erect burners. They are also very susceptible to variations in pressure, and at times give very poor light. They easily get out of order and require a great deal of attention. In some non-provided schools they are found in very bad condition. Refraction and reflection in certain forms of shades have been much recommended in America for school use. The "Prismatic" and "Holophane" globes were examined. The "Prismatic" globe has the outer surface of a glass bowl moulded into a series of prisms, running round the bowl, and so placed as to throw light downwards. It is very effective, especially when a flattened opal shade closes the mouth of the bowl. The combination is costly and heavy, and an equally good effect can be obtained with the 90° shade and globe. Indirect illumination by reflection is now a very favourite method in the newer German schools. By this method, powerful lights, usually arc lamps, are hung from the ceiling with metal reflectors below them, the light is thrown on to the white ceiling or to special reflectors, and reflected as a delightfully uniform and soft radiance over the whole room. The effect is not unlike daylight of modified brilliance, and it is most successfully employed in shops and showrooms, where the deep shadows of direct light would be destructive to the general effects of mass and colour required to be shown. It is, however, not good where continuous and detailed work at a desk is required. The system was adopted in the New Anatomical Laboratories of Cambridge University, but has had to be superseded by direct glow lamp illumination. With the increase of evening continuation schools, the lighting of the gateways and entrances of the schools becomes a matter of importance. At present the precincts of a school at night are generally the darkest part of a street, and the dark exterior is scarcely a fair indication of the light that shines within.

A Voice from the Argentine.—As we go to press, the following comes to hand:—

Sir,—In a moment of frivolity I wrote you a letter under the heading "How it was Done," which you were good enough to insert in your issue of October 25th.

This letter called attention to a remarkable example of newspaper science which appeared in the columns of the *Daily Mail*, describing the opening of the trans-Atlantic wireless service.

Little did I dream that in the wilds of the Argentine dwelt Nemesis in the person of Señor Gragnani, who, with few but well-chosen words, tells me in a Christmas greeting what he thinks of me. Thus:—

"Mendoza, Nov. 28, 1907.

"Mister,—On reading the stupid, base, nasty and senseless article written by you in the ELECTRICAL REVIEW of October 25, it reminds to me the ridiculous peoples who laughed at railways and other great inventions, and gave their doctorial opinion that nothing good could never be expected by said inventions.

"You pertain, my very little dear mister, to the worst part of humanity; the negative part of it; the beastly part, to call it properly.

"But never mind! Progress is going on all the same, in spite of the wickedness of all sons of —— like yourself.

"The only thing I regret is to be so far away distant; if I was a bit nearer I would have the satisfaction to spit in your —— face.—E. V. GRAGNANI."

There is a refreshing candour about Señor Gragnani's remarks, which is as rare as it is beautiful.

It is, of course, a little unfortunate that he has totally misconceived the intention of the article of which he disapproves in such a whole-hearted manner, but, in true mediæval fashion, he suggests that such heresy can only be accounted for by serious kinks in my moral character. Nay more, he would endeavour to save my soul at the cost of picturesque indignity to my body, if he were not so far away.

One can well imagine that if the telephone is a flourishing institution in Mendoza, Señor Gragnani has the time of his life when he feels called upon to chide a fellow townsman.

W. CLAYPOOLE.

London, S.W., *December 31st*, 1907.

[We are indebted to Mr. Claypoole for the opportunity of seeing the original communication, and regret that our publication of his humorous letter should have exposed him to the scurrilous abuse indicated, though not reproduced, above. This is what comes of quoting the *Daily Mail* in the Argentine!—EDS. E.R.]

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (BIRMINGHAM LOCAL SECTION).—At a recent meeting, the chairman, Prof. Kapp, announced a new departure in connection with the work of the Local Section. It had been pointed out that many members living in neighbouring towns found it very inconvenient to attend meetings owing to the difficulty of returning the same night, and that the attendance at meetings suffered on this account. Several members living in Birmingham had kindly offered to accommodate gentlemen living out of town, by putting them up for the night. The Committee now appealed to the members in the hope that others would come forward with the same offer. It was proposed that each member who volunteered in this way should hand to the secretary a list of names of gentlemen whom he would like to see, and who might, of course, be personal friends of his own. The visits could be arranged through the secretary prior to each meeting. It was hoped that members would enter into the spirit of this proposal, which would increase the attendance at meetings, and add to the usefulness of the Local Section.

JUNIOR INSTITUTION OF ENGINEERS.—By special permission of the Exhibition Executive and the other respective authorities, visits of this Institution were recently paid to the site of the Franco-British Exhibition at Shepherd's Bush, for an inspection of the constructional engineering work, &c., in process of erection there; the Exhibition extension works of the Central London Railway; and the generating station of that railway. The Central London Railway extension to the Exhibition will form a loop at the end of the railway, running up from the present Shepherd's Bush Station, passing through the yard, where a station will be constructed convenient for the Exhibition, and descending again by a tunnel that is now being constructed to the present Shepherd's Bush Station. In this way the trains will run round instead of being, as at present, "crossed-over" at the terminus. At the ensuing meeting a paper on "The Conduit System of Electric Tramway Construction," is to be read by Mr. Fitzroy Roose, of the L.C.C. tramways reconstruction department.

Electro-Harmonic Concert.—The next smoking concert will take place on the 10th inst. at the King's Hall, Holborn Restaurant. Mr. I. Probert will take the chair.

Appointments Vacant.—Mains assistant for Dewsbury (35s.); assistant rolling stock superintendent for L.C.C. (£250).

Another American Electric Railroad in Difficulties.—On December 31st receivers were appointed for the Chicago and Milwaukee Electric Railroad and allied corporations, representing a capital of nearly £6,000,000.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The annual dinner of the employés of the Merthyr Electric Traction and Lighting Co., held on Friday, December 12th, was made the occasion of a presentation, in the form of a valuable canteen of cutlery, to MR. R. L. MCCULLOCH, who is leaving to take up his appointment as managing engineer to the Leamington and Warwick Electrical Co. Mr. A. B. Cousins very ably presided and made the presentation.

MR. R. W. KLITZ, mains superintendent in the Wimbledon Council's electricity department, while replacing the H.T. fuse in one of the sub-stations where there had been a breakdown, was severely burned on his right arm and face, necessitating his absence from his duties for several days.

The Eccles T.C. has appointed MR. A. M. MULLINER, engineer-in-charge at the Southport Corporation electricity works, as assistant to the borough electrical engineer at a salary of £120 per annum.

Over 200 applications have been received by Carlisle T.C. for the post of electrical engineer.

The Hoylake and West Kirby U.D.C. has appointed MR. S. S. FOSTER, of Ilkeston, as assistant electrical engineer.

MR. E. P. BARFIELD, A.M.I.E.E., who has filled the position of lamp manager to the General Electric Co., Ltd., for the last eight years, has resigned his position with that company, in order to take up a similar position with Messrs. Siemens Bros. Dynamo Works, Ltd.

MR. J. C. ELVY, A.M.I.E.E., meter superintendent at the Saint Pancras Borough Council Electricity Department, has been presented by friends on the staff with a handsome salad bowl, suitably engraved, on the occasion of his marriage, November 30th, 1907, to Nellie Maud, daughter of Mr. Edward Mitchell, of Maidenhead, Berks.

Tramway Officials.—The Tramways Committee of the Halifax T.C. have selected the following to appear before them for the post of traffic superintendent, the salary being £250 per annum, rising to £350:—Mr. R. F. Rogers, Leeds; Mr. J. Caird, Aberdeen; Mr. E. Cloney, London Southern Tramways Co.; Mr. Thos. Tate, Wakefield and District Light Railway Co.; Mr. Edward Lafferty, Preston; and Mr. H. H. Saunders, Lowestoft. For the post of rolling stock superintendent (salary £130 per annum, rising to £160), the following "short list" has been compiled:—Mr. H. Hartley, Darlaston; Mr. Thos. Wilkinson, Haydock; Mr. G. Sidgwick, Stalybridge; Mr. J. W. Galloway, Rochdale; Mr. J. H. Burton, Wakefield; and Mr. E. Metcalfe, London.

On Monday, December 30th, a smoking concert was held at the Crown Hotel, Stourport, at which a presentation was made to MR. STEADMAN, late traffic manager of the Kidderminster and Stourport Electric Tramway Co., who was recently appointed traffic superintendent at Warwick. Mr. C. H. Jones of the "Corn Exchange" presided. The presentation was made by Mr. Cowderoy, of Barking, but formerly with the Kidderminster and Stourport Tramway Co. It took the form of a painted photograph of his family, together with a purse of gold on behalf of the employés of the Kidderminster Co. and the residents of Kidderminster and Stourport.

General.—MR. ARTHUR JACOB, M.I.E.E., has undertaken the control of the commercial organisation of the British Aluminium Co., Ltd., and has in consequence severed his connection with Messrs. Siemens Bros. Dynamo Works, Ltd., London. In addition to the development of the use of aluminium for general purposes, one of his chief aims will in the future be to extend its uses for electrical purposes

The *Times* states that Queen Wilhelmina has conferred a Commandership of the Orange Nassau Order upon M. Mercadier, director of the Telegraphic Service of the Agence Havas.

NEW COMPANIES REGISTERED.

Sheffield Sherardising Co., Ltd. (96,184).—This company was registered on December 21st, with a capital of £20,000 in £1 shares, to acquire the sole and exclusive license for Sheffield and the surrounding district under certain patents for the depositing of metals on metals known as the "Sherardising and analogous processes," to adopt agreements (1) with V. Dawson and (2) between the Sherardising Syndicate, Ltd., of the first part, the said P. Dawson of the second part, and this company of the third part, and to carry on the business of galvanisers, zinc works, steel and ironmasters, founders, manufacturers and blenders of alloys, electro-platers, engineers, &c. The first subscribers (each with one share) are:—R. Dawson, 84, Woodstock Road, Bedford Park, W., gentleman; W. W. Underwood, The Grange, Grendon Underwood, Aylesbury, gentleman; L. B. Keelan, 180, Kensington Park Road, W., gentleman; M. F. McTaggart, 127, Piccadilly, W., gentleman; W. J. Newall, 85, Gracechurch Street, E.C., mining engineer; P. Dawson, 6, Great Winchester Street, E.C., secretary; and C. E. Wilkey, 6, Great Winchester Street, E.C., accountant. No initial public issue. The number of directors is not to be less than three or more than five; subject to the second above-mentioned agreement, the subscribers are to appoint the first; qualification (except first directors) £100; remuneration, £50 each per annum and 10 per cent. of the profits in each year remaining after 10 per cent. has been paid on the shares.

Electrical Apparatus Co., Ltd. (96,191).—This company was registered on December 23rd, with a capital of £3,500 in £1 shares, to acquire the business of electrical engineers carried on by E. Schattner, F. H. Epstein, R. Amberton and R. Behrens, at Caxton House, Westminster, as the Electrical Apparatus Co., and to carry on the same and the business of electricians, suppliers of electricity, manufacturers of and dealers in motors, dynamos, accumulators, storage cells, insulators, lamps and other electrical apparatus and appliances, &c. The first subscribers (each with one share) are:—F. Epstein, 60, Compayne Gardens, W. Hampstead, N.W., electrical engineer; Miss C. Amberton, 16, Porchester Gardens, W.; R. Behrens, Caxton House, Westminster, electrical engineer; R. Amberton, 16, Porchester Gardens, W., electrical engineer; J. H. Epstein, 60, Compayne Gardens, W. Hampstead, N.W., gentleman; E. Schattner, Caxton House, Westminster, electrical engineer; Mrs. K. Schattner, 48, Culmington Road, Ealing, W.; and T. W. Hargreaves, 52, Coleman Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than two or more than four: the first are E. Schattner, F. H. Epstein, R. Amberton and R. Behrens; qualification 500 shares; remuneration £600 per annum, divisible.

Gasol Engineering Co., Ltd. (96,222).—This company was registered on December 24th, with a capital of £500 in £1 shares, to carry on the business of mechanical, electrical and marine engineers, millwrights, ironmasters, iron and brassfounders, manufacturers of steam engines, boilers, gas and electric generating appliances, gas and electric engines, motors and machinery, &c. The first subscribers are:—R. W. S. Gregory, 14, Manor Road, Westcliff-on-Sea, engineer, 50 shares; John McM. Shaw, jun., 5, Winton Avenue, Westcliff-on-Sea, engineer, 50 shares; Mrs. S. Shaw, 5, Winton Avenue, Westcliff-on-Sea, 50 shares; John McM. Shaw, 5, Winton Avenue, Westcliff-on-Sea, merchant, 1 share; L. Wakefield, 13, Havergal Villas, Green Lanes, N., clerk, 1 share; W. G. Gregory, 14, Manor Road, Westcliff-on-Sea, managing clerk, 50 shares; and Mrs. M. A. Gregory, 14, Manor Road, Westcliff-on-Sea, 1 share. No initial public issue. The number of directors is not to be less than three or more than seven; the first are R. W. S. Gregory, J. McM. Shaw and W. G. Gregory; qualification, £50; remuneration, £10 per annum, divisible.

Wm. Whitehouse & Co., Ltd. (96,234).—This company was registered on December 24th, with a capital of £50,000 in £1 shares, to take over as from December 31st, 1906 (?), the business carried on by W. Whitehouse and H. Pinnell (trading as "Wm. Whitehouse & Co."), at Empire Works, Brueton Street and Lawrence Street, Birmingham, and to carry on the business of gas and electric fittings manufacturers, brassfounders, art metal workers, &c. The subscribers (with one share each) are:—H. Pinnell, J.P., Blythe Hall, Knowle, Warwick, brassfounder; Mrs. M. E. Pinnell, Blythe Hall, Knowle, Warwick; C. H. Pinnell, Blythe Hall, Knowle, Warwick, brassfounder; A. Pinnell, Northwood, Station Road, Wylde Green, Warwick, brassfounder; W. Whitehouse, Holbeache House, Trimpley, Worcestershire, brassfounder; Mrs. M. Whitehouse, Holbeache House, Trimpley, Worcestershire; Miss A. M. Whitehouse, Oakenshaw, Redditch, Worcestershire. No initial public issue. The number of directors in not to be less than two or more than five; the first are W. Whitehouse and H. Pinnell, each of whom may retain office while holding £5,000 shares; ordinary qualification, £500; remuneration as fixed by the company. Registered office, Empire Works, Brueton Street and Lawrence Street, Birmingham.

Laminated Gears, Ltd. (96,180).—This company was registered on December 21st, with a capital of £10,000 in £1 shares, to adopt an agreement with S. W. B. McGregor, and to carry on the business of ironfounders, mechanical and electrical engineers, electricians, manufacturers of engines, boilers and machinery, tool-makers, &c. The first subscribers (each with one share) are:—A. E. Howard, 9-10, St. Mary-at-Hill, E.C., accountant; S. Palmer, 8, Lincoln Road, South Norwood, S.E., accountant; W. P. Thomas, Savernake, Bush Hill Park, rating surveyor; F. H. Sutton, Stock Exchange, E.C., stock-broker; J. F. Miles, Lyndhurst, Gamborne Road, Sutton, accountant; H. G. Jackson, 94, Grove Park, Denmark Hill, S.E., insurance clerk; and T. G. C. Coggins, 104, Valley Road, Streatham, S.W., clerk. No initial public issue; the number of directors is not to be less than two or more than seven; the subscribers are to appoint the first; qualification, 50 ordinary shares; remuneration, £60 each per annum (chairman, £80) and 5 per cent. of the net profits in any year when 10 per cent. dividend is paid, divisible. Registered office, 9-10, St. Mary-at-Hill, Eastcheap, E.C.

Mitcham Electric Fan Co., Ltd. (96,157).—This company was registered on December 20th, with a capital of £10,000 in £1 shares, to acquire and turn to account inventions relating to the production, storage, application, distribution and use of electricity, to adopt an agreement with the Dynamic Syndicate, Ltd., and to carry on the business of manufacturers of and dealers in electric fans, electric tools, induction coils, &c. The subscribers are:—J. Oswald, J.P., 23, Brompton Square, S.W., 250 shares; Major V. Paget, 91, Jermyn Street, S.W., 1,000 shares; A. Goodlet, 6, Parkhill, Carshalton, Surrey, chartered secretary, 1 share; A. N. Geldrum, 6, Broad Street Place, E.C., clerk, 1 share; N. Birmingham, 48, Lessar Avenue, S.W., stenographer, 1 share; T. S. Wegulin, 18, Clifford Street, W., stockbroker, 1 share; H. Wadsworth, 23, Rozel Road, Clapham, S.W., clerk, 1 share. No initial public issue. The number of directors is not to be less than three or more than five; the first are Commander L. W. P. Chetwynd, J. Oswald and Major V. F. W. A. Paget; qualification, 100 shares; remuneration, 50 guineas each per annum. Registered office, 6, Broad Street Place, E.C.

Electrical and Mechanical Exhibition, Ltd. (96,060).—This company was registered on December 13th, with a capital of £5,250 in 5,000 5 per cent. preference shares of £1 each, and 5,000 ordinary shares of 1s. each, to expose for sale and exhibit, in London or elsewhere, electrical and mechanical apparatus, inventions, machinery, appliances and manufactures for other companies, persons and firms, including storage accumulators, gramaphones and records, telephones, motor-cars and motors of all kinds, tires, motor accessories, time-recording apparatus, fire extinguishers, sewing machines, and arc, incandescent and other lamps; to act as agents for such companies, persons and firms in the said exhibitions, to provide buildings and showrooms, &c. The first subscribers (each with one preference share) are:—P. G. Wayne, Bryn Llyn, Corwen, North Wales, electrical engineer; E. W. Harding, 15, Mowbray Terrace, N.W., engineer; C. R. Whistler, Carlton House, Regent Street, S.W., secretary; H. B. Whistler, 1, Albemarle Street, W., secretary; F. Paul, 48, Dover Street, W., surveyor; F. C. Faulkner, Dallington, Northampton, automobile engineer; and Miss W. A. Reid, 228, Southwark Park Road, S.E. No initial public issue; the number of directors is not to be less than two or more than five; the subscribers to appoint the first qualification (except first directors), 100 shares; remuneration as fixed by the subscribers. Registered office, Carlton House, 11-13, Regent Street, S.W.

Bur-Kel Tram Rail Syndicate, Ltd. (96,070).—This company was registered on December 14th, with a capital of £6,000 in £1 shares, to acquire British patent No. 16,429 of 1907, for improvements in rails for tramways and the like, and to develop and turn to account the same. The first subscribers (each with one share) are:—W. E. von Reiffenstein, 3, Bush Lane House, Cannon Street, E.C., director; W. Swainson, 53, Mildmay Park, N., surgeon; J. de Horne, 3, Bush Lane House, E.C., journalist; E. S. McClatchie, 53, Mildmay Park, N., journalist; C. Kimber, 11, Bush Lane House, Cannon Street, E.C., secretary; J. Kimber, 11, Bush Lane House, Cannon Street, E.C., engineer; and Nettie Smith, 11, Bush Lane House, Cannon Street, E.C., clerk. No initial public issue; the number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, two shares; remuneration, one guinea each per meeting attended.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Westinghouse Brake Co., Ltd. (London). (16,033).—A debenture dated December 3rd, 1907, to secure £100,000, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled and unpaid capital. Holders: Parr's Bank, Ltd., 4, Bartholomew Lane, E.C.

A. C. Smith, Engineers, Lincoln, Ltd. (93,294).—Issue on December 4th of £500 4 per cent. debentures, part of series created November 20th, 1907, to secure £2,000, charged on the company's property, present and future, including uncalled capital. No trustees. No previous issue of same series.

Dulverton Electric Lighting Co., Ltd. (80,071).—This company's annual return was filed on November 30th, when 1,677 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £1,296 has been received, and £381 is considered as paid. Mortgages and charges: £2,000.

Newton's, Ltd. (48,936).—This company's annual return was filed on November 14th, when 3,265 shares had been taken up out of a nominal capital of £40,000 in £10 shares. £18,650 has been received, and £14,000 is considered as paid. Mortgages and charges: £10,000.

Spagnoletti, Ltd. (94,447).—The statutory report, dated October 23rd, shows 12,352 shares issued out of a nominal capital of £20,000 in £1 shares. £2,707 has been received, and £9,645 is considered as paid. £10,500 debentures (part of £12,500 authorised) were issued on October 22nd.

Nilmellor (England), Ltd. (94,441).—This company's annual return was filed on October 24th, when the entire capital of £5,000 in £1 shares had been taken up. £7 had been received and £4,993 was considered as paid. Mortgages and charges: Nil.

Rhondda Tramways Electric Supply Co., Ltd. (94,470).—This company's annual return was filed on November 13th, when seven shares had been taken up out of a nominal capital of £100 in £1 shares. No calls have been made. Mortgages and charges: £17,000.

Leicestershire and Warwickshire Electric Power Syndicate, Ltd. (72,274).—Issue on December 17th, of £100 6 per cent. debentures, part of series created July 9th, 1907, to secure £5,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £750.

I.T.E. Electric Co. (1907), Ltd. (London) (95,222).—Issue on December 6th of £2,400 5 per cent. debentures, part of series created November 29th, 1907, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series.

G. A. Steinthal & Boydell, Ltd. (94,610).—The statutory report, dated November 5th, 1907, shows 2,007 shares taken up, of which 1,000 have been allotted as fully paid, out of a nominal capital of £5,000 in 2,000 preference, and 3,000 ordinary shares of £1 each. No mortgages or charges registered.

Illuminated Signs, Ltd. (Clapham) (85,543).—Issue on December 17th of £175 7½ per cent. debentures, part of series created December 2nd, 1907, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £300.

Northern Counties Electricity Supply Co., Ltd. (67,924).—A trust deed, dated December 11th, 1907, securing £100,000 second debenture stock, has been registered. Property charged: Freehold lands and hereditaments at Cowper Quay, Merrington, Alnwick, Felling, Thirsk, Hirst and Shildon, leaseholds at Egypt, Hartlepool, and at Heworth, Hebburn and Malton, and the company's general assets, present and future (except uncalled capital), subject to £100,000 first debenture stock. Trustees: F. A. E. Samuelson, Breckenbrough, near Thirsk; and J. R. Hanson, Cliffden, Saltburn-by-the-Sea.

Huggett & Worthington, Ltd. (electrical engineers, Warrington). (94,634).—A debenture dated December 4th, 1907, to secure not more than £150, charged on the company's undertaking and property, present and future, including uncalled capital, and a debenture of even date to secure £350, charged on the company's undertaking and property, present and future, have been registered. Holder: W. W. Worthington, Hale, Cheshire (as guarantor of the company's account at the Lancashire and Yorkshire Bank, Warrington).

Llangollen and District Electric Light and Power Co., Ltd. (75,384).—A 5 per cent. debenture dated December 14th, 1907, to secure £400, charged on the company's undertaking and property, present and future, including uncalled capital, and (as collateral security) a second mortgage of certain leasehold property, have been registered. Holder: A. W. Blake, Cusop, Hay, Hereford.

Roger Dawson, Ltd. (electrical engineers, London), (72,635).—A debenture dated November 22nd, 1907, to secure £6,000, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: O. Nettlefold, 54, High Holborn, W.C.

British Prometheus Co., Ltd. (74,889).—This company's annual return was filed on November 27th, when the entire capital of £17,500 in 7,500 preference and 10,000 ordinary shares of £1 each had been taken up. £15,000 has been received and £2,500 is considered as paid. Mortgages and charges: £675.

Underground Electric Railways Co. of London, Ltd. (73,376).—Particulars of £400,000 debentures, created by resolution of November 27th, 1907, have been filed pursuant to Section 14 (4) of the Companies' Act, 1900. Property charged: £540,000 shares in the Baker Street and Waterloo Railway Co.; £1,585,000 shares in the Great Northern, Piccadilly and Brompton Railway Co.; £1,375,000 shares in the Charing Cross, Euston and Hampstead Railway Co., and £342,000 4 per cent. debenture stock of the same; and £378,700 ordinary shares in the London United Tramways, Ltd.; freehold land and buildings with fixed plant and machinery thereon in Lots Road, Chelsea; the cable subway and the company's cables therein running from the Lots Road premises to the District Railway near Earl's Court; the benefit of various agreements and other instruments; loose plant machinery, tools, implements, fuel, stores and similar loose chattels on the power house in Lots Road, aforesaid; unpaid capital amounting to £165,875; such lands acquired or leased for the purposes of the Baker Street and Waterloo Railway Co. and the Great Northern, Piccadilly and Brompton Railway Co. as are in excess of their actual requirements, and as the company is entitled to use as building sites under various construction contracts; and the company's undertaking and other assets. No trustees.

Marten & Jellicoe, Ltd. (electrical and general engineers, London), (94,313).—Issue on December 5th of £1,900 5 per cent. debentures, part of series created September 13th, 1907, to secure £10,000, charged on the company's property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,800.

Minehead Electric Supply Co., Ltd. (74,382).—A trust deed dated November 28th, 1907, to secure £5,000 debenture stock, has been registered. Property charged: Freehold hereditaments forming part of North Hill Building Estate, with buildings thereon, leasehold hereditaments near Alcombe, Dunster, with electric generating station and offices thereon, and the company's general assets, present and future, including uncalled capital. Trustees: Miss E. Clarke, West Lynch, Selworthy, Minehead; J. R. Davis, Minehead; and F. Risdon, Williton.

CITY NOTES.

The South American Light and Power Co., Ltd.

THE directors' report and statement of accounts for the six months ending March 31st, 1906, and for the year ending March 31st, 1907, states that the gross receipts for the first year under the new working conditions show only a small increase on those of the previous year owing to the re-arrangement of the cables which had to be made on account of the reduction of the voltage insisted upon by the municipality of Bahia Blanca. A large number of the distributing cables are now laid underground, which does away with a good many interruptions to the lighting formerly experienced from telephone wires falling across the Lighting Co.'s aerial cables. It will be seen by the following table that since March 31st, 1907, the business of the company has very materially increased both in the number of customers and also the number of lamps connected:—

	March 31st, 1906.	March 31st, 1907.	Sept. 30th, 1907.
Arc lamps connected... ...	70	126	292
8-C.P. incandescent connected	10,090	13,096	19,608
Fans connected	25	47	50
Customers	212	316	441

This increase of business has necessitated increased capital expenditure, especially in the way of underground cables, and, as this seems likely to continue, the directors have summoned an extraordinary general meeting to authorise an increase of the share capital of the undertaking to the extent of £50,000, to be issued as required to the Bahia Blanca and North-Western Railway Co. at par, in payment for the capital expenditure incurred by them on behalf of this company.

Mr. F. H. Jackson (chairman) presided over the fourth annual general meeting held at 6, Lloyd's Avenue, E.C., on Tuesday.

In moving the adoption of the report, the CHAIRMAN expressed regret at the delay which had occurred in holding the meeting, due to the fact that the certificate of the local auditors had not arrived. Dealing with the figures in the accounts, he pointed out that the profit and loss account from October 1st, 1905, to March 31st, 1906, showed a debit balance, due to the fact that the business of the company was entirely suspended during one month and partially suspended during three months, owing to their position with the municipality. The second profit and loss account for the twelve months ending March 31st, 1907, showed a small balance carried to the balance-sheet of £505. This would have been greater but for the fact that items were shown which would not recover. For instance, there was an item of £704 for directors' fees and expenses in visiting Bahia Blanca, and if that was eliminated it would make the profit and loss balance much better. On the credit side of the account it would be seen that the figures were worked out in accordance with the agreement with the Bahia Blanca and North-Western Railway Co., with which they were familiar. With regard to the balance-sheet, the authorised capital was £100,000, of which £50,000 had been issued. On the debit side there was an item of £18,261 to the Bahia Blanca and North-Western Railway, which was payable in shares. On the credit side was the figure of £24,800 for buildings, cables, machinery, &c., which had been added to the assets. The £18,261 on the debit side was the balance due to the railway company for the capital expenditure incurred, and was payable in ordinary shares at par. With regard to the item of £704 for directors' fee and expenses, he would like to say that Mr. Edmund Charrington was a well-known electrical engineer, who went out to Bahia Blanca at considerable inconvenience at the time when their difficulties with the municipality were in a very acute stage, and it was mainly due to his skill and negotiation that the agreement with the Bahia Blanca Railway Co. was arrived at. He (the chairman) considered it a very favourable agreement for the company. As to the prospects in the future, the comparative figures given in the report of the number of lamps connected showed the increase, especially during the past six months, to be extremely satisfactory and encouraging. From March 31st to September 30th, 1906, the gross receipts were £5,440, and during the period ending September 30th, 1907, they came to £8,840, an increase of £3,400. If the receipts for the remaining six months of the year showed a corresponding increase, the total gross receipts for the year should be something over £17,000, which, in accordance with the agreement with the Bahia Blanca Railway Co., would leave them a net profit for the year of about £3,000. They had £500 in hand, and would thus have about £3,500 to deal with. They had no depreciation to provide, as that was done by the railway company, and consequently under ordinary circumstances the whole of the balance would be available for dividend. It had, however, to be remembered that, shortly before entering into the agreement with the railway company, the directors, in view of increased demands, ordered a new dynamo and gas engine, but the railway company having decided not to continue working on the same system, would not take this over. They were negotiating for the sale of the gas engine, but would, of course, make a loss, and when the year was ended, and they had to consider the division of profits, they would have to deal with any loss thus made. After this year, however, the net profits would be available for dividend on the ordinary shares. If, as he hoped, the business went on increasing in the same ratio, they could reasonably look forward to a substantial dividend on the ordinary shares. He must, however, throw out a note of warning. A powerful gas company was now supplying gas with great satisfaction. As they knew, there had been considerable interruptions up to quite lately in the supply of electric current to their subscribers, and they had seen in the newspapers complaints about the company. The fact was that they had incurred considerable capital expenditure in putting down new cables and extending their works, and this had undoubtedly interfered with the supply to their customers. He hoped as the business got more consolidated, and the older parts of the town were fully equipped with cables and wires, their supply would be in every way satisfactory.

MR. T. P. GASKELL seconded the motion, and the report was adopted.

The meeting was subsequently made special, when a resolution was passed, increasing the capital of the company from £100,000 to £150,000.

The Burmah Electric Tramways and Lighting Co., Ltd.

THE report of the directors submitted at the ordinary general meeting on December 31st, 1907, states that for the year ending July 31st last the receipts have barely covered the expenditure, in spite of the fact that the outgoings for current expenses have not appreciably increased. During the year under review the plague continued with unabated activity, and the directors consider the decrease in the receipts, of about £1,000, is less than might reasonably have been expected. Since August last, when the plague was reported to have ceased, an improvement in the receipts has been manifested, small at first, but assuming later more considerable proportions. The directors regret to report that they have been unable as yet to evolve any satisfactory solution to the fuel difficulty. No coal has yet made its appearance in Mandalay, and the company have still to rely upon wood for their heating power, and for this reason it has been impossible to effect any reduction in the charges for power, which continue abnormally high. In January last the small extension, alluded to in the last report, was opened for traffic, and the directors believe that it will prove a useful adjunct when ordinary conditions are restored. The attention of the board has been constantly directed to every means possible to popularise the undertaking, by modifying the fares in such a manner as to meet the requirements of the public, and by utilising the plant and machinery in carrying out such additional work as is possible in the supply of light and power. As regards the competition from the vehicles which existed before the introduction of the tramways, this still exists to some extent, but is very slight on the lines where the cars are actually running. The greater speed and comfort of the cars has practically annihilated the competition of the gharries. The report does not only cover the period embraced by the accounts, but contains all the information available up to the present time, so that shareholders may know, as far as possible, what is the actual position. This is briefly summarised in the following paragraph. The company commenced operations in 1905. For the first year the traffics, though not such as the information supplied to the directors led them to anticipate, showed a tendency to improve, but the improvement was checked by the outbreak of plague in February, 1906, which then appeared in Burmah for the first time, and which continued in increasing volume until August of the present year. Notwithstanding this unlooked-for check a very large number of riders, about 50,000 per week, continued to use the tramways, so

that it was evident that the want of expansion was not due to any hostility to the tramways, but to circumstances entirely apart. The usefulness of the company in other directions is being developed, and the outlook seems generally to be more favourable. The directors do not wish to put too sanguine a view before the shareholders, but they wish to give them the opportunity of judging for themselves as to the actual position.

The ordinary general meeting was held on Tuesday, at the offices, 1, Queen Victoria Street, Mr. E. C. Morgan presiding.

In moving the adoption of the report, the Chairman said that the accounts showed that the expenditure remained about the same as last year. That item had been reduced to a minimum, because every detail of expenditure had been very carefully watched. However, since the balance-sheet had been issued their receipts were going back to their original figures, but not so rapidly as they could wish. Before long it would be necessary to take some drastic action to put the company right. At present they were just paying their way, and unless an improvement occurred they would seriously have to consider the question of winding up the company. They had to decide whether they were satisfied with what they were getting. The facts showed that they were, because their receipts had been as good as could fairly be expected under the circumstances, and the expenditure had been reduced to a minimum. They carried a large number of people—some 50,000 or 60,000, and, therefore, there must be a demand for the trams. If the number of people carried did not increase, then those who did travel would have to pay more for conveyance.

Mr. Henry R. Kindersley, in seconding the motion, remarked that he thought they could take a fairly favourable view of things. The people who had left through the outbreak of the plague were gradually returning, and they might look forward with some degree of confidence to the future. The town of Mandalay was rapidly growing, and although it was feared that Rangoon might be looked upon as the centre of operations, he thought that Mandalay was far better qualified, owing to its geographical position.

Replying to a Shareholder, the Chairman said that they had in many places arranged to supply energy for electric lighting purposes so that they would receive income from that source, which would figure in next year's balance-sheet.

The report was adopted.

Sunderland District Electric Tramways, Ltd.

The report of the directors giving the accounts for the 12 months ending October 31st, 1907, shows a loss on the year's working, after providing for debenture interest, amounting to £4,723 16s., bringing the loss to date up to £12,356. This loss will be slightly reduced by a payment by the Durham Collieries Electric Power Co., Ltd., being royalties for energy sold during the 12 months under their agreement with the company. Compared with last year the traffic receipts show an increase of £2,594. The ratio of working cost to receipts comes out at 75·41 per cent., as against 75·76 per cent. last year. The board have for some weeks been engaged in formulating a scheme which would be acceptable to the debenture-holders and shareholders, and after consulation with the trustees for the debenture-holders and some of the largest preference and ordinary shareholders, they have decided that the best way would be to create prior lien bonds up to £20,000, with a currency of 10 years, to issue £5,000 at once, and £10,000 as and when required during the next 12 months, holding £5,000 in reserve for contingencies. Special meetings of the debenture-holders and shareholders were called to obtain the requisite consents, and the documents dealing with the scheme were sent out to the debenture-holders and shareholders with these accounts. The board think that with the judicious expenditure of this further capital on the undertaking the traffics will show a considerable expansion. When the receipts grow so as to show a surplus profit, it will then be necessary to readjust the capital of the company, as without some such readjustment a distribution of dividends would appear to be impracticable. In March last, Mr. C. S. Cockburn was elected a director and in the following month was appointed chairman of the company, since which date he has devoted, without any remuneration, a great amount of time and attention in endeavouring to straighten out the company's finances. The other members of the board have also waived their fees for the past year, as well as abandoned their claim to other fees accrued and unpaid in previous years. The track-miles open and in use are 14½ miles, the number of cars 30. There have been no additions to either during the year. The board are taking steps to obtain the necessary powers to abandon the unmade portion of the line, and to obtain the release of the Consols deposit. Mr. G. Stratton has been appointed manager and took up his duties at Sunderland in June last.

The third annual meeting of the above company was held on Monday last at the Great Eastern Hotel, E.C., Mr. C. S. Cockburn presiding.

The Chairman, in moving the adoption of the report, said he much regretted that on that, the first occasion on which he had the pleasure of addressing the shareholders in the Sunderland and District Tramways Co., their board had not a more satisfactory tale to unfold, and more favourable accounts to present; however, speaking personally, he felt relieved that the situation was not much worse, and that he was not addressing them that day with a Receiver in possession and the interests of the preference and ordinary shareholders entirely wiped out. When he joined the board of the company last spring he found that of the £20,000 second debentures authorised at the last annual meeting, it had only been possible to issue some £14,000—and that there were debts and liabilities, some of them extremely urgent and pressing, totalling about £10,000. He had to take £3,000 of these second debentures himself, and to get some of their creditors to take a portion of their debts in these second debentures instead of insisting on cash. On that day—December 30th—they owed to tradesmen and others the sum of £2,885, and they were short of the debenture interest on January 1st £2,100, hence their asking them to sanction their borrowing £5,000 at once. There was no chance of recovering anything from the promoters of the concern, and from those responsible for its management in its early days, and so it was decided to completely change the policy and management of the undertaking, and by putting a united shoulder to the wheel to endeavour to put the tramcar on a sounder track than it had been running on up to date. That something had been accomplished in that direction he thought they would agree with him when he informed them that from September last, when the new management and policy had had time to get fairly to work, they had had traffic increases every single week for 16 weeks up to December 25th, the date of the last return. Those increases totalled £800 17s. 8d. For the eight weeks of their new year they had an average increase of £57 per week; beyond that, the working expenses, which came out for the year just ended to 75·41 per cent., had, for the past few weeks, been 69 to 70 per cent. Since November 1st they had reduced the car-mileage 1,000 miles a week, and yet they were carrying 4,000 more passengers. Until they spent some of the new money they were now asking for on the cars and on the track, he feared they could not get the working expenses down much below that figure; 15 of their cars were French, and from the commencement had been a constant source of worry and expense. The total sum they spent on car repairs for the year ending October 31st last came to £2,929 16s. 1d., of which some £1,200 was absolutely abnormal and due to the faulty workmanship and type of the cars mentioned; that was getting on towards the sum they were short of their debenture interest for the half-year ended Tuesday. In addition to their heavy repairs bill, there were four other items that had militated against the success of the company. In order to hasten the opening, as the power station was not ready, a gas plant was installed, which failed utterly and disastrously, for their cars, loaded with passengers, were stuck up all over their track and frequently remained out all night. That naturally gave the company a very bad name all over the district. Another thing that had not helped the company had been the fact that they had had two serious accidents—one last year and one this—both at the same spot, and both necessitating Board of Trade inquiries. They had also had to pay out considerable sums for damages and for premiums on insurance. Another point of leakage had been the miners' tickets issued in books to miners going to and from their work at the pits. The sum asked for these tickets was much too low, and on a careful account being taken, they found they were actually losing money on the contract. They would be glad to hear that the miners' leaders had agreed to recommend their men to acquiesce in a raising of fares. Another item might be mentioned as having affected their receipts in the past year, viz., "the weather." A happy augury for the future was the fact that very considerable building operations were in progress in the districts served by the lines. The working expenses had been, and still were, too high to be satisfactory, but to remedy this increased traffics were essential. The district they served was honeycombed with coal workings, some of them at no great depth as modern pits go. He had had considerable experience of subsidences as deputy chairman of a railway company working in a precisely similar district to this. No ingenuity and no foresight could protect them from them. The manager went to bed with his track in good order; next day he had to relay a hundred yards or so of line because it had sunk 4 in. to 6 in. It was a question of luck; one year they did not spend more than £300 on permanent way, and the next year they were faced with an outlay of £1,500. For the year from November 1st, 1906, to October 31st, 1907, the receipts per car-mile came out at 7·608, their power costs per unit ·790. The total operating costs worked out at 4·373; their total power costs at 1 370; and total working costs at 6·147d. The units per car-mile worked out at 1 685; the car-mileage was 758,532; and passengers carried 3,741,096. Turning to the report, the accounts showed a loss after providing for debenture interest, but before the payment of that item the profit came out at £4,600, as compared with the last available figure of £3,500 for the 16 months. The arbitration between the company and the Durham Collieries Electric Co. had not yet been settled, so that they did not know how much money they would receive from that source. As to the revenue account, of the £3,847 under the head of repairs and renewals, £2,929 had been spent on car repairs; management expenses, rates, &c., amounted to £2,944, of which sum £1,490 was for rates. With regard to the adjustment of the accounts with the Durham Collieries Electric Co. and others, amounting to £1,360, which amount was in their books as debts, they found on investigation they were proved to be worth nothing. They were more or less imaginary claims, so they had placed the loss to the revenue account.

Mr. Sydney seconded the motion, and the report was adopted without discussion.

Debenture-Holders' Meeting.

Following the ordinary meeting, a meeting of the debenture-holders was held for the purpose of considering the following resolution:—

"That this meeting of the holders of the first debentures of the Sunderland District Electric Tramways, Ltd., secured by trust

deed dated the 8th day of December, 1903, and made between the company of the one part and the Debenture Securities Investment Co., Ltd., of the other part, hereby sanctions the provisional agreement submitted to this meeting, which agreement is dated the 16th day of December, 1907, and is made between Charles Stuart Cockburn, purporting to contract on behalf of all the holders of the said first debentures of the one part, and the company of the other part, and assents to the modifications of the rights of the first debenture-holders and of the provisions of the said trust deed effected or to be effected by the said agreement, and authorises and empowers the trustees of the said trust deed to give effect to the same."

The circular accompanying the notice stated that the agreement empowered the company to raise further funds (not exceeding the aggregate nominal amount of £20,000), by the issue of a new series of 200 prior lien bonds of £100 each, or an equivalent amount of bonds of such less amount each as the company may think fit, repayable together with a bonus of £5 per cent. (*a*) on January 1st, 1918, or (*b*) on such earlier day as the principal moneys may become payable in accordance with the conditions to be endorsed thereon, or (*c*) at the option of the company on or at any time after January 1st, 1909, on six months' notice, ranking in point of security in priority to the existing debentures, and carrying interest at the rate of 5 per cent. per annum. In consideration of agreeing to the issue of such prior lien bonds the first debenture-holders will be entitled, so long as their respective debentures are outstanding, to 12½ per cent. of the surplus profits of the company in each year after paying debenture and mortgage interest and setting aside a sum not exceeding £2,000 per annum as a sinking fund for the redemption of the prior lien bonds, and (upon the revival of the sinking fund provided under the said trust deed) after payment by the company to the said last mentioned sinking fund of the annual sum of £2,285 4s.

The CHAIRMAN explained the reasons why further capital was wanted, and expressed the belief that the company had turned the corner, and it would be a calamity if a receiver were allowed to come in.

After discussion, MR. H. F. SMITH proposed the adoption of the resolution, which was seconded by MR. SIDNEY, and carried. Messrs. Reed, Bird and Gordon were appointed a committee to confer with the board in regard to the expenditure of the further capital.

Subsequently an extraordinary general meeting of the company was held and a similar resolution carried.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to allow the following securities to be quoted in the Official List:—

Underground Electric Railways Co. of London, Ltd.—Deposit receipts for 5 per cent. Profit-sharing Secured Notes.

United Electric Tramways of Monte Video, Ltd.—£600,000 first debenture stock.

The Stock Exchange Committee has ordered the undermentioned securities to be quoted in the Official List:—

Shanghai Electric Construction Co., Ltd.—32,000 shares of £10 each, fully paid, Nos. 1 to 32,000.

Shawinigan Water and Power Co.—Further issue of $48,500 5 per cent. consolidated first mortgage bonds of $500 each, Nos. 5,766 to 5,825 and 5,839 to 5,875.

Havana Telephone Co.—Bonds in exchange for provisional scrip certificates will be ready early in January. Intimation will be given to the debenture-holders in due course as to lodgment of scrip certificates in exchange for bonds.—*The Times.*

Belgium.—A company has just been formed in Brussels with a capital of £8,000 and the title La Société Belge des Lampes Electriques.

Simplex Conduits, Ltd.—An interim dividend at the rate of 6 per cent. per annum for the half-year ended December 31st, 1907, on the preference shares has been declared.

STOCKS AND SHARES.

New Year's Eve, 1907.

IT is a good thing for Mark Tapley that he never had to dabble in financial journalism, else he would have lost his character. The redoubtable optimist, set down to comment upon the following sets of statistics, might be defied to extract half-a-dozen grains of cheer from the load of depression carried by each little list. In fact, the only drop of consolation which will appear to most is, that prices have got so low that they cannot really go much worse without total extinction intervening, and that, accordingly, the chances are in favour of some recovery. We leave it at that.

Were one so evilly-disposed, it would be easy to dilate at length upon the miseries of the past year in that corner of the world of finance which is of chief interest to those concerned in the various branches of electrical business. We should have no trouble in writing many columns upon the misfortunes of the supply companies, the bad times as regards obtaining fresh capital by any undertaking, the refusal of the public to look at investments erstwhile such favourites. We respectfully doubt, however, whether such chapters of woe would interest the reader already familiar with the chestnutty story, and maybe that reader will be more than content with the figures here presented in a form designed to give the salient items of information for assimilation in the shortest time. The headings are self-explanatory, and the first list deals with the market in electricity supply shares. The great event of the year may be said to have been the withdrawal, for the time being, of the L.C.C. Bill for the municipal, wholesale, supply of current, and how much effect this movement has had upon prices in the share market, the following figures tragically show. We ring up the curtain:—

Ordinary Shares.	Dec. 31, 1906.	Dec. 31, 1907.	Rise or Fall.	1907. Highest.	1907. Lowest.
Brompton and Kensington	7⅞	7⅛	— ¾	8⅜	7½
Charing Cross	3¾	4⅛	+ ⅜	4⅛	3⅝
City of London	10	10	—	10⅝	9
County of London	8	7	— 1	9	6⅞
Edmundson's	3	2⅝	— 2⅜	2⅝	⅜
" Preference	5	1⅛	— 3⅞	4¼	1
Metropolitan	7⅛	5⅞	— 1¼	8	5
Notting Hill	14	11	— 3	14	11
St. James'	10	7⅞	— 2⅛	10	7½
Urban	3⅜	1½	— 1½	3½	1⅜
Westminster	9½	8½	— 1¼	10¼	7⅞

From our list of electrical railway securities, City and South London stock shines as a bright exception to the profound dullness in other issues. Fears of labour troubles overhung the whole railway market for several months. Dear coal and dear money have been with us all through the year, and the crushing competition amongst the traffic-carriers of the Metropolis has provided a disastrous contribution to the causes that led to the sorry result here tabulated:—

Stock.	Dec. 31, 1906.	Dec. 31, 1907.	Rise or Fall.	1907. Highest.	1907. Lowest.
Central London Ordinary	83	63½	—19½	83	54½
" " Deferred	73½	42½	—31	73⅜	40⅛
City and South London	42	44	+ 2	50½	39
Great Northern and City Pref.	3½	1½	— 2	3⅝	1½
Metropolitan	60	39	—21	60½	31½
Metropolitan District	19	9	—10	19½	7½
Underground E.R. Profit Notes	90	37	—53	90	35

Telegraph stocks and shares have not escaped in the general "rot" which seized the investment market in its grip several months ago, and which is only gradually relaxing its grasp now. However, prices in this section finish the year in most cases substantially above the worst, while National Telephone stocks are even higher than they were a year ago. Here are a few representative examples:—

Stock or share.	Dec. 31, 1906.	Dec. 31, 1907.	Rise or Fall.	1907. Highest.	1907. Lowest.
Anglo Preferred	109	100	— 9	112⅞	91
" Deferred	27⅞	16⅛	—11⅝	28¾	12⅛
Cuba Submarine	8¼	6⅜	— 2⅛	8¾	6⅛
Direct U.S.	15⅛	13⅛	— 2	16⅜	12
Eastern Extension	13⅜	12⅝	— ¾	14⅛	11
Eastern Telegraph	136½	132½	— 4	142½	120½
Great Northern	36½	31½	— 5	39	30½
Indo-European	59	53½	— 5½	60½	52
Western Telegraph	13½	1 ⅛	— ⅜	14⅛	1⅞
National Telephone Preferred	108	110	+ 2	111½	101½
" " Deferred	106½	107½	+ 1	112⅜	101

Transport work the world over has proved a poor business in 1907, judging by the prices of stocks, and the next set of prices brings out this statement clearly enough. Anglo Argentine shares benefited, of course, by reason of the new scheme whereby the old Ordinary have become second Preference:—

Stock or share.	Dec. 31, 1906.	Dec. 31, 1907.	Rise or Fall.	1907. Highest.	1907. Lowest.
Anglo-Argentine	7⅛	8	+ ⅞	8½	7⅛
British Columbia Electric Def.	129½	125½	— 4	135	123
British Elec. Traction Ordinary	4⅜	1½	— 2⅞	4⅝	1⅜
" " Preference	8¼	5⅛	— 3⅛	8⅝	4⅝
Cape Electric	¼	¼	—	⅜	⅛
London United Preference	8⅞	7⅞	— 1	9⅛	7⅜
Metropolitan Electric Tram Pref.	⅞	⅞	+ 1/32	1	⅞

One of the worst events in the acute stage of the United States financial crisis was the appointment of a Receiver in America for the parent company of the Westinghouse concerns. This produced a crash in the Debenture stock of the British Westinghouse Company, and the current quotation is practically the lowest reached during 1907. No further feature of such drastic fluctuation has occurred amongst manufacturing shares, but the trend of prices, as in other markets, has been mainly downward, as our last—and, fortunately, our final—list shows:—

Stock or share.	Dec. 31, 1906.	Dec. 31, 1907.	Rise or Fall.	1907. Highest.	1907. Lowest.
Babcock & Wilcox	4	3⅜	— ⅝	4⅛	3⅛
British Insulated	6⅝	6¼	— ⅜	7⅜	6⅛
Brush Ordinary	⅞	⅝	— ¼	1	⅝
British Westinghouse Preference	1⅝	1	— ⅝	1⅞	¾
" Debenture	73	45	—28	73	45
Callender's	10	10	—	11½	9½
Electric Construction	⅜	⅜	—	⅜	⅜
Edison & Swan	1¼	1	— ¼	1⅜	¾
Henley's	11½	11	— ½	13	10½
India-Rubber	16½	15	— 1½	16½	14½
Telegraph Construction	31	29½	— 1½	33	27½

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Dec. 25	2,463	+ 110	30	42,560	— 1,379	14·4	..
Ayr	,, 28	373	+ 31	33	10,723	— 101	8	..
Bath	,, 25	1,390	— 147	52	40,539	— 1,952	13	..
Belfast	,, 27	7,980	+ 655	39	144,048	+ 9,414	36	..
Birkenhead	,, 29	2,103	+ 76	38	41,662	+ 76	13·62½	..
Birmingham Corp.	,, 21	13,913	..	38	234,693	..	56·46	..
Blackburn	,, 25	2,201	+ 151	39½	44,182	+ 2,980	14½	..
Blackpool Corp.	,, 26	690	+ 58	..	47,647	— 1,235	11·87	..
,, —Fleetw'd.	,, 28	457	+ 88	25	23,105	— 888	8·25	..
Bolton	,, 29	4,289	+ 399	39	88,990	+ 5,693	26	..
Bournemouth	,, 25	2,842	+ 159	38½	67,506	+ 1,502	21·5	..
Bradford	,, 28	9,584	+ 780	39	182,373	+ 4,257	54·9	1
Brighton	,, 29	1,541	+ 47	40	36,457	— 2,980	9·6	..
Bristol	,, 27	10,779	+ 311	..	..	..	28·5	..
†Brit. Elec. Trac. Co.								
Airdrie	,, 13	227	+ 24	49	11,111	+ 54	3·65	..
Barnsley	,, 13	166	+ 22	,,	8,284	+ 225	..	..
Barrow	,, 13	226	+ 21	,,	12,690	— 196	5·37	..
Cavehill	,, 13	50	+ 9	,,	4,126	— 221	..	..
Devonport	,, 13	418	+ 12	,,	24,602	— 243	8·85	..
Gateshead	,, 13	1,028	+ 74	,,	49,881	+ 1,849	11·26	..
Gravesend	,, 13	205	+ 10	,,	12,071	— 3	6·5	..
Greenock	,, 13	494	— 48	,,	32,080	— 603	7·25	..
Hartlepool	,, 13	237	+ 4	,,	14,259	— 630	6·72	..
Kidderminster	,, 13	89	+ 8	,,	5,864	— 90	..	..
Leamington	,, 13	129	+ 17	,,	8,018	— 572	3	..
Merthyr	,, 13	211	+ 28	,,	10,455	+ 679	2·9	..
Metropolitan	,, 13	4,480	+1,454	,,	230,606	+63,008	22	..
Middleton	,, 13	305	+ 42	,,	17,899	+ 8	8·5	..
Mid. Joint Com'tee	,, 13	5,738	+ 175	,,	289,328	+ 4,646	..	..
Oldham—Ashton	,, 13	548	+ 15	,,	29,801	+ 1,166	9·18	..
Peterborough	,, 13	107	+ 13	,,	6,257	— 126	5·81	..
Potteries	,, 13	1,985	+ 116	,,	93,785	+ 2,912	29	..
Rothesay	,, 13	67	+ 30	,,	10,352	— 627	2·75	..
Southport	,, 13	198	— 11	,,	14,586	— 710	8·17	..
S. Metropolitan	,, 13	657	..	,,	39,460	..	..	..
Swansea	,, 13	838	+ 90	,,	45,515	+ 3,224	5·5	..
Tynemouth	,, 13	138	+ 2	,,	11,820	— 738	3·75	..
Weston-s-Mare	,, 11	96	+ 2	,,	7,056	— 379	3	..
‡Worcester	,, 13	249	+ 22	,,	13,979	— 126	5·75	..
Wrexham	,, 13	89	— 5	,,	5,062	— 91	..	..
Yorks. Wool. Dist.	,, 13	842	+ 12	,,	45,969	+ 739	17	..
Miscellaneous	,, 13	196	+ 30	,,	11,012	— 176	..	..
Burnley	,, 28	2,638	+ 246	..	..	..	7·5	..
Burton-on-Trent	,, 29	599	— 32	39	11,224	— 549	11	1·5
†Bury	,, 15	1,028	+ 218	..	..	..	10·5	..
†Cardiff	,, 14	2,091	+ 150	37	80,416	— 2,450	15·87	..
Carlisle	,, 28	963	+ 37	52	9,089	— 484	..	..
Chatham and Dist.	,, 26	1,451	+ 170	52	87,207	+ 1,479	12·16	·68
Cork	,, 26	992	+ 34	52	23,966	— 851	9·89	..
Croydon	,, 27	2,916	+ 390	39	55,919	— 1,518	12	·75
Darlington	,, 28	432	+ 30	39	8,351	+ 26	..	..
Darwen	,, 27	520	— 2	39	10,025	— 17	4·36	..
Dover	,, 21	347	— 14	38	8,874	— 1,186	4·75	..
Dublin	,, 27	10,906	+ 743	..	168,020	+31,758	54·25	5·5
Dundee	,, 25	2,310	+ 252	52	66,870	+ 1,295	13·25	..
East Ham	,, 28	1,830	+ 195	39	35,721	+ 802	7·75	..
†Exeter	,, 6	240	— 12	36	11,507	+ 551	4·75	·5
Glasgow	,, 28	34,432	+1,764	29½	529,685	+16,242	89·25	5·5
Hastings	,, 26	1,727	..	..	..	..	..	..
Huddersfield	,, 28	3,110	+ 320	39	62,578	+ 2,589	28	..
Hull	,, 28	5,378	+ 367	39	96,695	+ 5,464	13	..
Ilkeston	,, 25	264	+ 45	39	5,615	+ 355	3·5	..
†Ipswich	,, 14	809	+ 5	37	15,321	— 1,109	10·5	..
Isle of Thanet	,, 28	520	+ 109	52	32,172	— 126	11	..
Kilmarnock	,, 28	291	— 8	52	5,147	— 118	4·25	..
Lan'kshire Trm Co.	,, 26	2,480	+ 788	52	62,631	+16,782	15·82	3·26
Lancashire United	,, 25	2,404	+ 452	52	65,514	+14,434	39	1
Leeds	,, 21	12,722	+ 965	38	249,740	+10,738	51·13	..
Leicester	,, 28	4,613	+ 209	..	..	..	..	..
Leith	,, 21	935	+ 33	31½	16,699	+ 60	6	..
Liverpool	,, 21	21,969	+ 97	51	556,880	+ 7,680	104	..
†‖L.C.C.	,, 14	30,298	+5,057	37	1,161,585	+192,409	116·5	10
London United	,, 27	12,264	+1,640	..	334,119	+15,351	..	..
Lowestoft	,, 18	397	+ 94	13	2,254	+ 98	3·5	..
Manchester	,, 28	29,357	+3,094	39	580,247	+40,227	86	11
Newcastle	,, 28	8,476	+ 541	39	160,510	+ 1,130	..	..
Newport	,, 28	1,359	+ 86	39	27,023	+ 2,026	14·5	..
Northampton	,, 27	873	+ 45	37½	17,089	— 368	5·5	..
Oldham	,, 29	3 831	+ 729	40	77,907	+ 5,585	29·75	..
Pontypridd	,, 28	709	+ 340	39	10,674	+ 4,091	5	1·75
Portsmouth	,, 14	2,986	+ 97	37	75,124	— 1,500	14·5	..
†Preston	,, 18	667	+ 7	..	..	..	..	..
Reading	,, 26	1,357	+ 90	38½	24,381	— 666	13·25	..
Rotherham	,, 26	1,388	+ 240	38½	23,706	+ 3,887	10	·66
Salford	,, 23	8,876	+ 115	38	178,277	+ 4,606	38·9	..
Sheffield	,, 22	11,178	+ 573	39	217,670	+ 9,978	35·75	..
Southampton	,, 25	1,987	+ 245	38	40,318	+ 2,227	..	..
Southend-on-Sea	,, 25	563	+ 80	39	16,300	+ 64	..	..
Sunderland	,, 29	2,607	— 63	39	54,220	— 1,181	..	..
†Swindon	,, 18	147	— 3	..	..	..	4·4	..
Tyneside	,, 25	808	+ 17	52	23,705	+ 936	8·87	..
Wallasey	,, 28	1,545	+ 38	39	33,128	+ 727	8·72	·22
Walthamstow	,, 29	1,159	+ 302	39	24,086	+ 906	9	..
West Ham	,, 26	4,978	+ 490	39	90,898	+ 2,146	14·7	..
†Wolverhampton	,, 18	788	— 43	37	35,196	+ 170	12·5	..
†Yorks. W. Riding	,, 8	1 084	+ 87	49	56,924	..	..	..
Baker St.-Waterloo	,, 28	5,970	+1,475	26	66,015	+22,305	4·25	1
Cen. London Rly.	,, 28	11,268	— 631	26	137.805	—19,910	6	..
Char. +, Eus. Hamp.	,, 28	6.120	..	26	69,745	..	7·75	..
City & S. Lon. Rly.	,, 29	6,977	+ 474	26	82,315	+ 10,778	7·3	1·05
Dublin-Lucan Rly.	,, 27	324	+ 7	26	3,423	+ 223	1	..
G.N. and City Rly.	,, 28	3,578	— 94	26	44,088	— 1,011	3½	..
G.N., P'dy. & Brmp.	,, 28	10 290	+3,955	26	113.310	..	9	·25
L'pool Overh'd Rly.	,, 29	2,607	+ 33	26	39,751	+ 1,776	6·8	4·3
Mersey Railway	,, 28	4 117	+ 403	26	48 445	+ 3,440	4·5	..
Metropolitan Rly.	,, 29	32,677	+ 686	26	395.785	+ 7,190	24·5	..
Met. District Rly.	,, 28	17,052	+1,556	26	203,593	+ 2,194	24	..
†Anglo-Argentine	,, 28	18,360	+ 961	51	863,859	+80,586	48	..
§Auckland	,, 6	11,788	+1,463	48½	126,351	+ 6,464	19·2	·56
§Brisbane	Nov.	13,570	+1,734	..	..	..	..	..
§Brit. Columbia Rly.	,,	37,375	+11,902	22	167,944	+48,363	6·8	4·3
Buenos A. & Belgr'o.	Dec. 23	7,787	+ 149	51	197,537	+10,861	..	..
Calcutta	,, 28	6,668	+2,080	..	..	..	..	..
§Cape Electric T. Ld.	August	9,240	..	..	..	..	..	..
§Geneva	Nov.	7 533	+ 321	..	..	..	..	..
§Kalgoorlie, W.A.	October	3,963	..	43	39,925	..	20·5	..
Madras	Dec. 15	1,223	+ 222	50	26,431	+ 4,386	12·75	·5
§Lisbon	October	7,970	..	..	..	..	..	..
Perth (W.A.)	Dec. 27	3,419	— 429	52	73,478	— 3,058	25·6	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

MARKET QUOTATIONS

Wednesday, January 1st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	38/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£23 10	..
a Lead, Nitrate	per ton	£31	..
a ,, White Sugar	per ton	£32	..
a ,, Peroxide	per ton	£39	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3¼d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	125/-	95/-
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lumps	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3¼.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£168	..
b ,, Wire, in ton lots	per ton	£150	..
b ,, Sheet, in ton lots	per ton	£145	..
v Babbitt's metal ingots	per ton	£50 to £125	dec.
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	½d. inc.
c ,, Tube (brazed)	per lb.	9¼d.	dec.
c ,, ,, (solid drawn)	per lb.	8¼d.	..
c ,, Wire, basis	per lb.	7¾d.	inc.
c Copper Tubes (brazed)	per lb.	10d.	dec.
c ,, ,, (solid drawn)	per lb.	10d.	dec.
g Copper Bars (best selected)	per ton	£78	£2 dec.
g Copper Sheet	per ton	£78	£2 dec.
g ,, Rod	per ton	£78	£2 dec.
e ,, (Electrolytic) Bars	per ton	£64	..
e ,, ,, Sheets	per ton	£81	..
e ,, ,, Rod	per ton	£70	..
e ,, ,, H.C. Wire	per lb.	8¼d.	..
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	9/-	..
n German Silver Wire	per lb.	1/6½	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	3/5	1d. dec.
Iron, Charcoal Sheets	per ton	..	..
i ,, Pig (Cleveland warrants)	per ton	49/9	..
,, Forgings, according to size	per ton	..	..
,, Scrap, heavy	per ton	..	..
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£15	..
g Lead, English Ingot	per ton	£14 10 to £14 15	dec.
g ,, ,, Sheet	per ton	£15 14 to £15 19	dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 5	£1 inc.
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/2	..
p ,, rolled bars & rods	per lb.	1/2 to 1/3	..
p ,, strip & sheet	per lb.	1/2½ to 1/5	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	10d.	..
r Steel, Magnet, in bars		£60	..
q Tin, Block (English)	per ton	£135 10 to £136 10	£8 10 inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/10	..
p White Anti-friction Metals—			
"White Ant" brand	per ton	£40 to £60	dec.
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£25	20/- dec.

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

The Bank Rate.—The Bank Rate was yesterday reduced to 6 per cent.

France.—La Société des Tréfileries de Havre (Lazare Weiller), telegraph and telephone wire manufacturers, of Havre, report a profit of £87,708 for the last financial year. A dividend of 10 per cent. is being declared, as against only 8 per cent. in the preceding 12 months.

The balance-sheet of La Compagnie d'Electricité de l'Ouest-Parisien (Ouest-Lumière), Paris, for the last financial year shows a profit of £34,130, out of which a dividend of 6 per cent. is being declared, the same as for the preceding 12 months.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Dec. 17th.	Closing Quotations Dec. 31st.	Business done week ended Dec. 31st, 1907. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2¼ — 3½	2¼ — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	84 — 87 xd	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7½%	7⅛%	7⅛%	8 %	105 —108	105 —108	..	..	..	7 8 2
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	88 — 90	83 — 90	..	..	..	4 8 11
660,660	Anglo-American Telegraph	Stock	61s.	2⅜%	3½%	3⅞%	55 — 58	55 — 58	57	..	..	6 13 7
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5⅛%	6 %	6 %	99 —101	99 — 101	100	99	..	5 18 10
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	1⅜%	15 — 15½	16 — 16½	16	15⅛	+1	10 12 1
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	82 — 86	80 — 84 xd	82⅞	81	..	4 15 3
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15 — 16	15 — 16	..	..	..	6 5 0
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3¼— 3¼	3¼— 3¼	65/-	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 8⅝	8½— 8⅝	8½	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710£	Direct United States Cable	20	3 %	3½%	4½%	4⅝%	18½— 19⅝	18⅝— 19⅞	13 5/16	18⅜	+ ⅛	6 18 4
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	99 —101	..	..	—1	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	129 —134	130 —135	134	131½	+1	5 3 8
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	99½	..	..	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜— 12⅞	12⅜— 12⅞	12⅞	12⅜	..	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98½—100½	98½—100½	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5⅜%	5⅜%	5⅜%	5⅜%	9½— 10½	9½— 10	10	9½	— ⅛	5 10 0
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	12½— 13½	12⅝— 13	12 13/16	12⅝	— ⅛	4 12 4
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	15 %	24 %	24%	20 %	30½— 32½	30½— 32½	..	..	..	6 3 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55	52 — 55	..	..	..	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3⅜%	50 — 55 xd	53 — 58	..	..	+3	6 0 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	55 — 65 xd	60 — 65	..	..	+2½	6 3 1
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16— 3/16	3/16— 3/16	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1⅛— 1⅛	1⅛— 1⅛	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	1— 1	1— 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	109 111	110⅜	107½	+1	5 8 11
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	107 —109	107½	106¼	+1	4 13 6
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	8 %	6 %	10¼— 12½	10⅛— 12½	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅞— 5 7/16	5⅝— 5 7/16	5⅝	5½	..	4 11 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3 %	⅛7 — 99	96 98 xd	97⅜	..	..	3 11 5
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	98 —100 xd	101½	..	..	4 0 0
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6⅛%	6⅛%	7 %	7 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	5 17 11
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	5 1 1
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839†	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	90 —102	98 —101	..	..	—1	4 9 1
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127	124 —127	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅜— 7⅜	6¼— 7 xd	..	..	..	5 14 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4⅜— 5⅜	4⅜— 5⅛ xd	..	..	..	4 15 3
15,60 0†	West African Telegraph, Shares	10	4 %	44%	4 %	4 %	10 — 10⅜	10 — 10⅜	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	24%	1⅛— 1⅜	1⅛— 1⅜	22/6	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	12⅜— 13½	12⅜— 13½	13	12⅜	..	5 6 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	98½—101½	97 —100	99	..	—1½	4 0 0
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	9/4½	7/6	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7 — 7½	7½ — 7⅝	..	..	+ ⅛	1 6 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6⅞— 7⅛	7⅛ — 7⅜	..	..	+ 1/16	Nil
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	98 —101	..	..	—1	4 19 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	..	8 %	8 %	8 %	7½— 8¼	7½— 8¼	8	7⅞	..	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5⅛%	5⅛%	5⅛%	5⅛%	5⅛— 6⅛	5½— 6 xd	6 1/16	5⅛	— 1/16	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	128 —131	125 —128 xd	..	..	—3	4 13 9
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —106	101 —104	..	..	—2	4 16 2
880,000	Babcock & Wilcox, 1 to 880,000..	1	17 %	20 %	20 %	20 %	3⅛— 3⅜	3⅛— 3⅜	73/1½	70/7½	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 3/16	1 1/16— 1 3/16	..	..	..	3 16 10
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	3½— 4¼	3½— 4¼	..	..	..	8 4 8
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4⅛— 5	4⅛— 5	..	..	..	7 0 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4¼— 4⅝	4¼— 4⅝	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾— 4¼	3¾— 4¼	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	5 13 5
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	95 — 98	95 — 93	97	..	..	5 12 8
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	124 —127	124 —127	125	124½	..	4 10 3
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	107 —111	105 —109	105⅝	..	—2	4 11 9
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	99 —103	99 —103	102	102¾	..	4 17 1
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1¼— 1⅜	1¼— 1⅜	31/6	28/9	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	5 — 5⅛	5 — 5⅛	5⅛	5⅛	..	10 18 2
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	90 — 93	90 — 93	91¾	90	..	5 7 6
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	70 — 75	70 — 75	..	..	..	6 0 0
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾— 7	6⅞— 6⅞	..	..	— ⅛	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛	5⅝— 6⅛	6⅛	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.. ..	100	4½%	4½%	4½%	4½%	101 —104	100 —103	..	..	—1	4 7 5
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅞— 1⅛	⅞— 1⅛	15/-	..	..	Nil
1,016,853	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	45 — 55	40 — 50 xd	46	45½	—5	8 0 0
50,000	‡Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— 1⅛	⅝— 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	0 — ½	0— ½	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	½— ½	½— ½	..	..	..	Nil
125,000£	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	6 12 4
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	65 — 68	65 — 68 xd	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅜— 4⅝	4⅜— 4⅝	90/3	90/-	..	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
18,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115 xd	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	101 —104 xd	..	..	—1	4 16 2
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	6⅜— 6⅞	6⅜— 6⅞	..	..	..	5 16 4
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,380..	5	..	..	5 %	5 %	5 — 5⅛	4⅞— 5⅛ xd	..	..	— ⅛	4 13 0
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	101 —105	99 103	..	..	—2	4 7 5
85,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅛	9⅜— 10⅛	9⅝	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛— 5⅜ xd	5⅛— 5⅜	5⅜	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½—107½	104 —106 xd	..	..	—1½	4 4 11
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 3/32— 1 5/32 xd	1 1/32— 1 1/16	..	..	— 1/32	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	101—104	101 —104	..	..	..	4 6 7
911,568	Central London Railway, Ord. Stock..	Stock	4 %	4 %	4 %	4 %	62 — 65	63 — 66	65	63	+ 1	6 1 3
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84	..	..	4 14 2
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	41 — 44	42 — 45	43	..	+ 1	8 17 10
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2½%	43 — 45	43 — 45	43⅞	43½	..	4 14 5

* Unless otherwise stated, all shares are fully paid. ‡ A period of nine months. † From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 31st.	Closing Quotations Dec. 31st.	Business done week ended Dec. 31st, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1 9/16 — 1 11/16	1 9/16 — 1 11/16	..	..	..	8 6 8
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1 5/16 — 1 3/8	1 5/16 — 1 3/8	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	%	6 %	6 %	6 %	1 — 1 1/16	1 — 1 1/16	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	99 —102 xd	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	12 3/4 — 13 1/4	12 3/4 — 13 1/4	..	..	..	4 8 11
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12 1/2 — 13 1/2	12 1/2 — 13 1/2	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1/8 — 1/4	1/8 — 1/4	19/6	18/6	..	11 7 6
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	1 1/2 — 2 1/2	1 1/2 — 2 1/2	40/7½	39/4½	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	79 — 82	78 — 81 xd	..	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/8 — 1/4	1/8 — 1/4	6/9	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1/8 — 1 1/8	1/8 — 1 1/8	18/3	17/6	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8 1/8	7 3/4 — 8 1/4 xd	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1 1/2 — 1 3/4	1 1/2 — 2	..	..	+ 1/4	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10 1/4 — 10 3/4	10 1/4 — 10 3/4	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10 1/2 — 11 1/2	10 1/2 — 11 1/2	11 1/2	10 11/16	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5 1/8	5 — 5 1/8	..	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —106	104 1/2 —106 1/2	..	..	+ 1/2	4 4 6
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	15 1/2 — 16 1/2	14 1/2 — 15 1/2 xd	..	..	..	6 9 0
37,500	‡Liverpool Overhead Railway, Ord.	10	1½%	½%	Nil	Nil	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..	Nil
10,000	‡ Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 — 8 1/4	8 — 8 1/4	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6 1/4 — 6 3/4	6 1/4 — 6 3/4	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6 1/4 — 6 3/4	6 1/4 — 6 3/4	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7 1/8 — 8 1/4	7 1/4 — 8 1/4 xd	7 3/4	..	..	6 1 3
1,881,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	79 — 83 xd	81	80	..	4 16 5
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 3/16	1/8 — 3/16	..	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	93 — 96	91 — 94	93	..	—2	4 15 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 1/8	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 3/16	1/8 — 3/16	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 18 9
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	28 1/2 — 30 1/2	28 1/2 — 30 1/2	28 1/2	..	..	5 7 2
150,000‡	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
599,300	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	35 — 39	35 — 39	..	..	..	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	3/4 — 1 1/4	3/4 — 1 1/4	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3 1/4 — 3 3/4	3 1/4 — 3 3/4	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	75	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5½%	5½%	5½%	4 5/8 — 5 1/8	4 5/8 — 5 1/8	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
386,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	98½	..	..	4 0 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3 7/8 — 4 3/8	3 7/8 — 4 3/8	..	..	..	5 2 10
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	81/10½	..	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
49,496	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	70/-	..	..	5 5 11
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	100 —103 xd	..	..	—2	4 7 5
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 1/2 — 10 1/2	9 1/2 — 10 1/2	10 3/8	9 7/8	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	..	..	..	5 0 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	120 —124 xd	..	..	—2	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	93 — 96 xd	94½	..	—2	4 13 9
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3 3/4 — 4 1/4	3 3/4 — 4 1/4	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4 3/8 — 4 5/8	4 3/8 — 4 5/8	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6 1/2 — 7 1/2	6 1/4 — 7 1/8	..	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 10 1/2	10 — 11	10 3/8	10 1/2	+ 1/4	5 9 1
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	105 —108	103 —106 xd	107	..	—2	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98	95 — 98	97	96	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	3/8 — 7/16	3/8 — 7/16	..	..	..	11 6 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1 1/8	1 — 1 1/8	..	..	..	10 0 0
850,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	75 — 80	70 — 80	71	..	—2½	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5%	5%	4 1/2 — 5	4 1/4 — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4 1/4 — 5 1/8	4 1/4 — 5 1/8	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6 3/8 — 6 7/8	6 3/8 — 6 7/8	..	..	..	6 10 11
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1 1/2 — 1 3/4	1 1/2 — 1 3/4	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 — 4 1/2	4 — 4 1/2	..	..	..	6 13 4
974,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 91	87 — 91	..	..	..	4 18 11
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8%	10 %	10 %	8 %	5 3/8 — 5 7/8	5 3/8 — 5 7/8	..	..	..	6 16 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4 1/2 — 5	4 1/2 — 4 5/8 xd	..	..	— 1/8	4 12 7
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	102 —106	100 —104 xd	..	..	—2	4 6 7
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	85 — 90 xd	85½	85⅜	—2	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 3/4 — 99 1/2	94 — 97	..	..	—2½	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6 1/2 — 6 3/4	6 1/2 — 6 3/4	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5 1/8	5 — 5 1/8	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	10 1/2 — 11 1/2	10 1/4 — 11 1/2	..	..	..	6 10 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5 3/4 — 6	5 3/4 — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7 1/2 — 8 1/2	7 3/4 — 8 1/2	7 7/8	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 3/4 — 7 1/2	6 3/4 — 7 1/2	..	..	..	4 13 4
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	87 — 92	85 — 90	..	..	—2	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1/2 — 1 1/2	1/4 — 1 1/4	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 76	71 — 75	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	8 %	4 %	4 %	8 %	2 3/4 — 3	2 3/4 — 3	53/9	..	..	5 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	1/2 — 9/16	1/2 — 9/16	..	..	..	3 6 8
117,988	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 5/16 — 1 3/8	1 5/16 — 1 3/8	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1 7/8 — 2 1/4	1 1/2 — 2 1/4	..	..	+ 1/4	12 10 0
55,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1 1/2 — 2 1/4	1 1/2 — 2 1/4	42/6	..	..	8 18 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	90 — 93	90 — 93	..	..	..	4 16 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	7 3/4 — 8 1/2	7 3/4 — 8 1/2	8 1/16	..	..	6 17 2
81,979	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4 5/8 — 5 1/8	4 1/2 — 5 xd	99/4 1/16	98/9	— 1/8	4 10 0

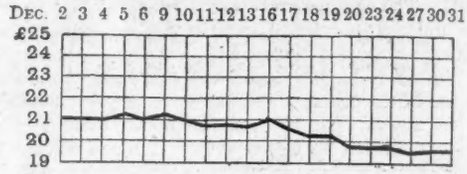
* Unless otherwise stated, all shares are fully paid. ‡ Quotations on Liverpool Stock Exchange.

Bank rate of Discount 7 per cent., November 7th, 1907.

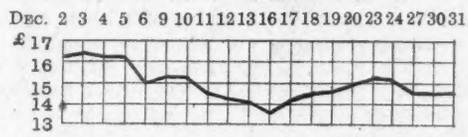
METAL MARKET.

Fluctuations in December, 1907.

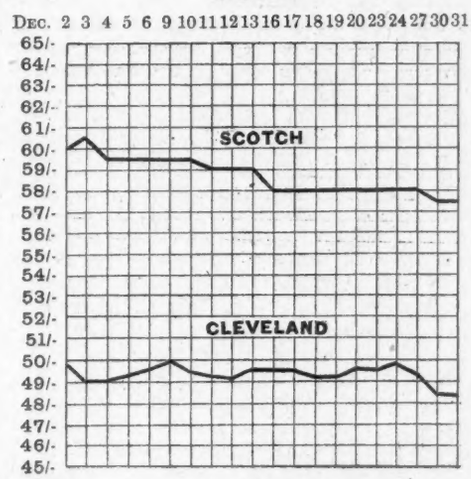
SPELTER (G.O.B's.).



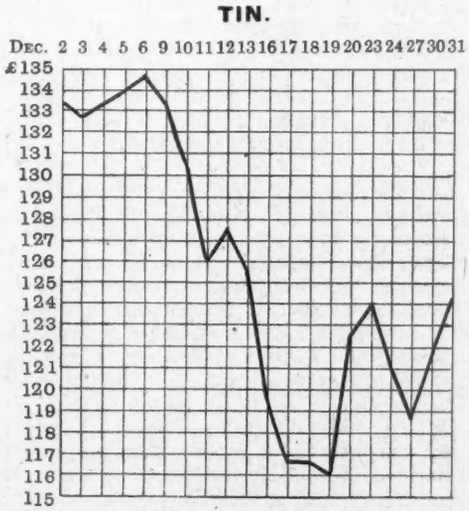
LEAD (ENGLISH).



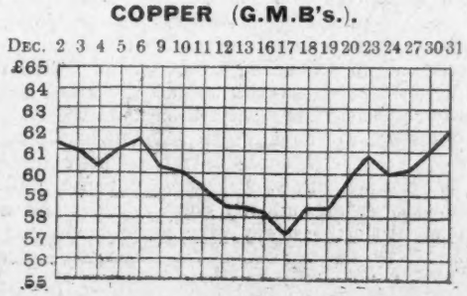
IRON.



TIN.



COPPER (G.M.B's.).



REVIEWS.

The Patents and Designs Act, 1907, with Notes and the Practice thereunder. By JAMES ROBERTS, ESQ., of the Inner Temple, and H. FLETCHER MOULTON, ESQ., of the Middle Temple, barristers-at-law. London: Butterworth & Co. Price 4s.

To quote from the preface, this work does not pretend to be a treatise on patent law. It is merely intended to fill a gap which must necessarily exist until the new Patent Act of 1907 has become the subject of judicial scrutiny. "Its object," say the authors, "is to give assistance to the reader in the interpretation of the new enactments, and to point out their practical effects."

That some such work is necessary will be apparent to any one who has endeavoured to keep pace with the legislative evolutions which have resulted in the Act of 1907. This Act makes important changes which nearly affect the interests of inventors; but it does more, it repeals and re-enacts in the form of a code all the older Patent Acts. Any work, therefore, which shows the reader where the old enactments are to be found in the new Act is of considerable value. We can confidently recommend the work before us on this ground, because the authors have so annotated the sections that references to the older Acts can be found at a glance. Further, an appendix gives references to the sections of the old Acts, with the corresponding sections of the new.

The introduction consists of an admirable summary of the Patent Laws of England, illuminated by frequent references to Mr. Roberts's well-known work, "The Grant and Validity of British Patents for Inventions." The second part of the work is devoted to the Act of 1907; while the authors have added an appendix containing abstracts of certain recent cases before the Comptroller, and the comparative table above alluded to. We strongly recommend this work to all who desire to be initiated into the mysteries of the Patents and Designs Act, 1907.

An Introductory Course of Continuous-Current Engineering. By ALFRED HAY, D.Sc., M.I.E.E. London: Constable and Co., Ltd. Price 5s.

This book forms a most acceptable adjunct to the elementary electrical treatises more commonly used by first and second-year technical students.

Whilst retaining simple methods of treatment, it deals with the subject from a distinctly practical point of view, without, however, lapsing into inexact language. The ground covered includes descriptions and explanations, by the aid of very clear diagrams, of measuring instruments, dynamos, motors, boosters, secondary cells, switches and cut-outs, arc and incandescent lamps and photometers—in fact, of the whole of the electrical apparatus commonly met with in a direct-current station. There are also some introductory chapters on electro-magnetic principles, and some excellent notes on the origin and properties of the various metals and insulators used in electrical work. Most of the chapters include a set of questions on the matter dealt with, and there are also some useful approximate data of the cost of electrical apparatus. The general arrangement of stations, mains, &c., is not dealt with.

Turning to the details of the book, some points calling for future revision may be indicated. In the explanations of magnetic effects a preference is shown for dealing with the idea of polar quantities of magnetism rather than with the magnetic circuit idea which appeals so much more strongly to the average student brought up on Ohm's law. On p. 94, in referring to wave-wound armatures, it is stated that the number of conductors ± 2 must be divisible by the number of poles. There is no such restriction on the number of conductors, but only on the number of "coil-sides." Furthermore, wave windings, in contradiction of the statement on p. 93, may have different pitches at the back and front without loss of symmetry.

The fact that an actual reversing voltage exists as soon as the current density under the toe of the brush exceeds that under the heel is not clearly brought out in dealing with

carbon brush commutation on p. 109. Also the voltage drop at each brush contact, which is given as 1 to 1½ volts on p. 110, only reaches half this value with many of the soft carbons in use.

For the time of short-circuit on p. 113, the time for a point on the commutator to pass over a distance equal to the brush width plus the width of a segment is used instead of merely the time to pass the brush width.

On p. 117 and p. 164 it is claimed that the demagnetising ampere-turns of an armature due to brush shifting can be directly determined by a simple formula. This would be the case if there were no distortion of the field, but in practice there is always appreciable distortion, and it is the angle of the brushes to the effective (distorted) magnetic neutral line which counts rather than their angle to the geometrical neutral line.

In describing the Hopkinson efficiency test on page 185, no mention is made of the "series" method, in which the auxiliary generator is connected in series with the main machines. This method is, it is true, less accurate than the "parallel" method, but, especially when testing high-voltage machines, it is often more convenient. Finally, the statement on page 294, that overload cut-outs should never be inserted in the generator circuit, is contradicted on page 305.

These points, however, do not seriously detract from the value of the book, which undoubtedly helps to fill a gap between the elementary "Electricity and Magnetism," and the specialised book on electrical design.

Typographical errors are satisfactorily scarce—the only one noticed being on page 5, where $\frac{i\,i'}{r}$ occurs in place of $\frac{2\,i\,i'}{r}$.

In a number of cases diagrams are printed in duplicate on neighbouring pages, presumably in order to simplify reference.

A Handbook of Wireless Telegraphy. By J. ERSKINE-MURRAY, D.Sc. London: Crosby Lockwood & Sons. Price 10s. 6d.

While this book does not pretend to form a comprehensive treatise nor yet to be simply a popular elementary work, a middle course has been pursued by the author with the object of making it useful and interesting to those who have already made themselves fully acquainted with the elementary principles of wireless telegraphy. A perusal of the work gives rise to the idea that beyond this commendable object there is a not inconsiderable desire displayed to air original theories and explanations formed by the author. This is, of course, quite natural and pardonable, but it requires great impartiality, self-restraint, and a sound well-balanced judgment only obtainable by wide experience, to follow out this course without incurring the suspicion of bias and becoming too controversial for a professedly educational work. In our opinion, the author has been led by this tendency into debatable ground in many parts of the work, instances of which will be quoted.

The opening chapter briefly summarises some of the early attempts to adapt the electric current to produce effects at a distance, and a small section is devoted to the conduction and induction methods. In this relation exception must be taken to the implied statement that the so-called Armstrong-Orling system has been developed so that it is possible to bridge enormously greater distances by its means than by previous methods. It would be interesting to know what evidence can be produced in support of this surprising statement. In the same chapter the author, referring to resonance effects in electric circuits at low frequencies, gives a little calculation to show that in general very large capacities are necessary to produce resonance in alternating-current circuits at the ordinary frequencies used in supply stations. Here he is very unfortunate in his figures, inasmuch as the inductance of the circuit, which he assumes to include the field magnets (!) of an alternator, is taken at 1 *millihenry*. On p. 29 occurs another statement requiring evidence to substantiate it, viz., that in Marconi's untuned system of transmission one wave of large amplitude, with perhaps three or four waves following of much less amplitude, is emitted at each discharge. This is, of course, merely a re-echo of what appears in almost every text-book on the subject, but it yet remains to be proved that such is the case. The sharpness of tuning which it is possible to obtain under proper conditions from such a system belies the statement.

Chapter IV is largely devoted to discussing the theory of the action of the coherer, and it seems a pity that after so extensive a treatment one remains unconvinced as to the conclusions arrived at by the author. It will require much stronger evidence than is given in this chapter before the view that the particles in the coherer adjust their positions and take up a chain formation can be accepted. Such an explanation appears to fail in several particulars, one being that it fails to account for the action of coherers consisting of two electrodes touching without making actual electrical contact, in the absence of any conducting particles. When this effect is fully explained, it will no longer be necessary to postulate any motion or "lining-up" of the particles in the filings coherer, for the simple reason that the same explanation of coherence between particle and particle or particle and electrode will hold as for the coherence between two fixed electrodes only. Nor can the author's dictum that some degree of coherence is effected for even the feeblest oscillations or "jigs," as they are called in this work, be accepted. The basis on which this conclusion is arrived at is not sound.

Another matter in the same chapter which calls for comment, relates to the Schaefer anti-coherer. It is stated that a scratch on silvered glass is made with a diamond to divide the silvering into two parts. The usual practice is to cut the silver deposit with a sharp razor, so that the glass surface is in no way scratched; but it is the explanation of the action of the device to which more serious exception is taken. We are told that under the microscope small torn particles of silver may be seen flying to and fro across the gap under the stimulation of 3 or 4 volts from the battery applied, and that these act as carriers of a convection current amounting to quite a number of milliamperes! Is Dr. Erskine-Murray really serious, or is this intended for a joke?

In connection with the subject of sound-reading *versus* recording receivers, a misapprehension is apparent in the author's mind, which it would be well to remove. Sound-reading instruments are, in practice, found to be in every way superior to recording instruments where skilled operators are concerned, whether messages are in code or plain words, and there is no rule in the Post Office telegraph service which demands that code messages must be repeated if sound-reading instruments are used. Both in point of accuracy and expedition sound-reading receivers are preferred.

A description of some old-fashioned forms of receiving transformers or "jiggers" is given in Chapter XVI, which date back to the time when such appliances were looked upon merely as transformers, and not as coupled resonant systems, which they really are. As simple transformers with forced frequencies of oscillation, such devices are practically useless, and it is, therefore, rather surprising that the author should think it worth while to dilate upon details of construction of this type of appliance while ignoring later practice altogether.

Omitting a number of other matters on which comment laudatory and otherwise might be made, we come to that upon which Dr. Erskine-Murray appears to lay the greatest stress—viz., the theory of transmission which he advocates. The theory, which, by the way, appears so far to have escaped serious criticism and to have received support in high places, is based on the assumption that the propagation of wireless telegraph waves is effected in a dielectric layer of air between two conducting layers, one of which is the earth's surface, and the other conducting rarefied air in the upper atmosphere. The grounds upon which the assumption that rarefied air or rarefied gases generally have come to be regarded as conductors appear to require a little clearing up. Can Dr. Erskine-Murray, or any other physicist, give reference to experimental authority which will show that rarefied gases are conducting in any other circumstances than when "ionised" by the application of a sufficiently high E.M.F.,

or, to be more accurate, an electric field of sufficient density, or else by ionisation by other well-known means? In other words, is it not a fact that rarefied gases are normally non-conductors? If we require them to conduct they have to be stimulated to conduction, and it will require a much greater density of field than that of an electric wave in wireless telegraphy to produce this stimulation. Even assuming the necessary conductivity, it appears very doubtful whether they would be capable of acting as reflectors of waves rather than absorbers. It may be argued that the atmosphere is ionised by the rays of the sun, and this is no doubt true. But does it help such a theory, seeing that day-time transmission is so much less effective than night transmission? On the whole, we are inclined to think that the weight of circumstantial evidence is against rather than for such a theory.

One more matter only will be dealt with. This time it is a sin of omission, not of commission. No professedly educational work on wireless telegraphy can now be regarded as complete without some reference to the effects of coupling resonant circuits or systems together in different ways and degrees. The author dismisses the subject in the preface with the remark that with the means now at disposal in practice, the coupling can be settled in the course of a brief experiment which is as satisfactory as any mathematical treatment can be. This amounts to begging the question. To carry out such an experiment effectively it cannot be brief, especially if it is required to eliminate disturbing stations, and it is eminently necessary that the experimenter should have a thorough grasp of the theory of coupling. It involves a principle which no expert and no practical wireless telegraph engineer can afford to ignore, and the total omission of the subject cannot, therefore, be lightly excused.

Les Industries Electro-chimiques. By Jean Escard. Paris: Librairie Polytechnique Ch. Béranger. 1907. Price 25 fr.

According to the sub-title this volume is a practical treatise upon the electro-chemical manufacture of non-metallic bodies and their compounds, *e.g.*, chlorine, alkalis, bleaching powder, ozone, and nitric acid; of alkali, alkaline-earth, and the common metals; of electrolytic copper and nickel; of rare metals, or metals intended for special uses; and of organic substances. In fact, it covers the whole domain of electricity as applied to chemical industry, with the sole exception of those smelting processes in which the current is utilised as a mere heating agent. The book extends to nearly 800 pages, and is divided into 10 chapters. The different chapters relate respectively to theoretical considerations and the best conditions for the preparation of given materials by electrical agency, the manufacture of non-metallic elements and their compounds, the production of chlorine, the alkalis and compounds between them, the ozonisation of air, the fixation of atmospheric nitrogen, the manufacture of alkali and alkaline earth metals, the electrolytic preparation of the common metals and their purification, the production and refining of copper and nickel, the preparation of raw metals, and finally the production of organic bodies.

M. Escard appears to be a prolific writer, having already presented his readers with several books on electrical and electro-chemical subjects. Amongst these is one on electric furnaces and their employment, whence smelting is not mentioned in the volume now before us. Being no amateur, M. Escard has the knack of writing straightforwardly and lucidly, so that his explanations of principles, and his descriptions of processes, are both intelligible and concise. So far as we have been able to examine his most recent work, it appears to be an excellent compendium of nearly all the successful, and many of the unsuccessful, processes which have been essayed or adopted in practice: at least that is the case when due regard is had to the secrecy naturally maintained about small but essential details relating to some of the operations involved in applied electro-chemistry and electro-metallurgy. The chapter on aluminium, that interesting if elusive metal, is full and admirable, sufficient space being devoted to the most modern suggestions for competing with the Héroult-Hall process of reduction. The chapter on nitric acid contains a good description of the Birkeland-Eyde process, but says little about the properties of the final product, and nothing at all about its uses or the prospects of success before the inventors.

The final chapter deals with hydrocarbons, alcohols, chloroform and its analogues, recuperation of glycerin, chloral, cellulose, the reduction of nitrobenzene and its homologues, &c., and the production of acetic acid from wood; the use of electricity in preparing antitoxins, yeast, and saccharine liquids; and, finally, electrical tanning, the sterilisation of milk, and the employment of an electric current or discharge to stimulate the germination of seeds. Each chapter is followed by a full bibliography of the subject treated, in which foreign authors are not altogether neglected, and the whole volume concludes with a fairly comprehensive index. The book can be recommended to all students who are sufficiently at home in the French language to read it fluently.

THE CANAL INQUIRY.—II.

[COMMUNICATED.]

In our previous article we pointed out that by taking advantage of the laws of wave propagation in canals, it would be possible with towage from the bank at a speed above an average of 10 miles an hour, to considerably reduce the tractive effort demanded in haulage, and to do away with the damage to the banks caused by the wash of the trains of following waves, which would no longer be generated. Thus the proverbial two birds with one stone would for once in a way be secured; also, while an accelerated service would be attained which for slow goods would be amply sufficient, the cost of maintenance involved, instead of being augmented, would even be diminished thereby. We venture, therefore, to commend this idea to the serious consideration of the Canal Commission when considering their recommendations.

The second condition which, as we pointed out, must be complied with to render our canals fit to take their place in a general system of up-to-date transportation, was that their traffic should be worked by trains of barges, instead of by single units, so as to correspond as far as possible with the requirements of modern transportation in bulk, and to meet the demand for the expeditious loading of ships at our ports and the general doing away with warehousing by the consignee. The Chinese, who developed a vast network of canals uniting their river systems long before canals were dreamed of in Europe, and who laid them out on the most economical lines by studying the contours of the country very carefully and avoiding all redundant earthwork, discovered long ago that it did not pay to handle single units even with human and animal haulage; thus, as far as possible under the peculiar conditions of their traffic, they worked their barges in trains of two, three and four together. To do this with the narrow tortuous canals, which economy of location and construction had necessitated, they invented what may be called a hinged multiple-barge which could readily go round not only sharp curves but even right-angle elbows. Each unit composing this multiple-barge had its stern slightly recessed so as to accommodate a portion of the circular bow of the succeeding unit, and from both bow and stern of each boat eyes projected, which, when brought together to form the multiple-barge, received a stout wooden pin or coupler, very ingeniously secured by rope lashing. In this way short and narrow units suited to the structural features of the cheaper branch canals could be made to form respectably large units or trains of units to suit the traffic conditions of the main canals, and enable freight to be transported in the greatest bulk of which the system of haulage would admit. Although our old-fashioned canals are many of them far wider than the average Chinese canal, and none of them are either so narrow or so tortuous as the narrowest in China, this expedient of the hinged multiple-barge would be almost as useful here as it has been in China. It would do away with the necessity for altering, often at prohibitive expense, the dimensions of the tunnels and bridges and the width of the canals themselves to suit a

uniform minimum standard barge of 300 tons capacity, which the evidence before the Commission indicates as the smallest economical size. Instead of a 300-ton barge, on this plan of coupling the units, six 50-ton barges, or three 100-ton barges, could be joined together to form a multiple hinged barge, which would answer just as well from the point of view of economical haulage as the larger unit. Also the canals to which the original small barges were suited could be left unaltered, save in respect of lock accommodation and traffic appliances, and in this way the entailed expense could be kept within reasonable limits. It is perfectly obvious that it would be impossible to deal with trains of barges, even if composed of coupled units of suitable size, either expeditiously or economically, without altering the present locks; and further, that unless these trains of barges could be transferred from one level to another without uncoupling, that is, as one train, and without the excessive waste of water that the present system of locking and unlocking involves, our canals would still remain useless, because of the excessive expense and loss of time involved in working them.

Here, again, the Chinese afford us a clue to the solution of the difficulty. The Grand Canal, instead of being provided with locks, is provided with inclined paved ways from one level to another, over which the barges and junks are hauled on rollers with capstans and ropes. By this system a minimum waste of water is involved, which is more than made up by natural additions to the water on the higher reaches due to rainfall drainage. The chief objection to working many of our canals has always been the scarcity of water in the higher reaches and the excessive cost involved in its supply by pumping, and this, under any comprehensive scheme of enlargement to suit single barges approaching in size the economical modern standard, would be greatly intensified. The Chinese method of "portage" over inclined planes, which it may be added is, or has been, in use in many places on Continental canals, and even originally in this country, is a promising way out of the difficulty. On each side of the present locks, inclined ways could be constructed provided with rails on which low trucks, carrying cradles for the bottom of the barges to rest on, and linked together by a suitable system of couplings to form an endless chain, would work. They would move always in one direction, up one side to a position just above the water-level, then down to the level of the bottom of the upper reach, across the bottom of the canal, and up again once more on the further side to just above water-level, and down that side to the level of the bottom of the canal, then across the same, and so on. The single or multiple barges, arriving at the bottom of an incline on their proper traffic side, would be hauled into the funnel entrance of the incline and on to the moving cradles, and rest thereon, to be progressively carried singly or as a train up to the higher level, and launched automatically on to the upper reaches. Those arriving at the top of an incline, also on their proper traffic side, would be similarly treated, and launched at the foot of the inclined way on to the lower level. The linked chains of cradles might either be kept continuously moving at a slow rate of, say, 1½ ft. a second, or about a mile an hour, or so designed as to be started, worked and stopped by the same power by which haulage is effected on the canal itself. The cost of these inclined planes with their equipment of moving cradles, and of working them, would be considerably less than that of enlarging and remodelling existing locks to suit tugs and barges of 300 tons' capacity at a single locking, and of providing the water for working them.

By adopting devices of the above kind, it would again be possible to bring down the proverbial two birds with one stone—that is, the locking arrangements could be remodelled to handle trains of barges at least as expeditiously as a single barge is now handled, while the expenditure of water could be reduced considerably below the present rate.

We have now to consider the system of haulage which would have to be adopted to work canals efficiently in accordance with modern requirements. Having no experimental guide available in our own islands, where we believe no system of mechanical traction has ever been tried, we have again to turn to foreign experience for a lead. Horse traction was the original system of haulage adopted in this country, and to this form of traction we have religiously adhered ever since; although fairly adapted for the handling of single barges at the average rate of 3 or even 3½ miles an hour, it could not deal with either large barges or trains of barges carrying 300 or more tons of freight per unit, and moving at an average rate of over 10 miles an hour.

Everyone will readily admit that here is a case where electric traction is indicated as the most suitable, and indeed, considering all the circumstances of the case, as the only suitable form of traction for working our canals.

The generation of power at well-designed, suitably situated central stations, and its distribution to conveniently situated subsidiary stations carefully arranged so as to suit the existing network of canals in the manufacturing districts of the Midlands and of Lancashire and Yorkshire, could be provided for on the most economical lines. The main generating stations could, without any difficulty, be placed in almost every case either at the pit mouth, where unsaleable slack might be utilised for steam making and the working of turbo-generators, or in the vicinity of the great coke-making ovens, the smelting works and blast furnaces, &c., which abound in those countries, to utilise the waste gases for working large internal combustion engines of modern type directly coupled to generators for the production of electric current.

If each lock required the installation of a special steam plant to work the inclined lifts where required, at irregular intervals along the canals, the engineer who had to plan and work the installation would have a hopelessly expensive and unsatisfactory task before him, but, on the contrary, the task would be quite manageable, when the problem only involved the distribution of electrical power, generated elsewhere, to the electric capstans, and to the motors of the inclined lifts. Similarly, if the traction of the barges themselves involved the supply of coal to each tractor employed from depôts continually requiring replenishing, placed at frequent intervals all along the canals, by an auxiliary service of barges from the coal pits to the depôts there established, the prospects of rehabilitating our canal system would be poor indeed. Quite another and more manageable problem is presented when electrical tractors are involved, supplied at every point on the canal tow-paths by current from a central generating station. A single tow-path, however, with the implied exchange of tractors between traffic in contrary directions when meeting, would be out of the question at the increased speed at which the traffic would be worked under the improved conditions which we have been advocating.

It is evident that the additional expense of providing a second tow-path throughout would have to be faced, so that there should be an independent tow-path for the up traffic and another for the down traffic. Another advantage attaching to the adoption of electric traction would be that it would involve a minimum of structural alteration in the existing bridges crossing, and other structures connected with, the canals, as the size of the tractors could be adapted to suit the limited headway of tow-path passages in almost every case. Expense would, however, be necessarily involved in extinguishing the rights of way which have in many cases been acquired by the public in connection with canal tow-paths, as, of course, with an accelerated speed of working and an intensified traffic, the public could no longer be admitted thereto with safety.

The closing of the present tow-paths to the public would, however, at worst, involve the closing of comparatively short pieces of such public footpaths, as in the majority of cases a footpath could be provided at fairly moderate expense parallel to the tow-path on canal land, separated therefrom by a light iron fence, by the simple expedient of doing away with the old-fashioned hedges on each side of the canal.

The earliest form of electric tractor tried on the Continent was a kind of traction engine running on the ordinary tow-path, but it was found necessary to repair and maintain tow-paths to the standard of an ordinary road to enable the tractor to work satisfactorily and avoid its pulling itself into the canal, as the wear and tear caused by the horses' hoofs rendered the tow-paths unusable. It was soon apparent that a cheaper and more satisfactory alternative to road-making and maintenance was the laying of sleepers and rails and the substitution of locomotives for the comparatively inefficient and unsuitable tractor. The nature of the pull

exerted in towing barges from the canal tow-path necessitated either the use of locomotives wholly disproportioned in weight to the tractive effort they were called upon to exert or the provision of a specially super-elevated inner rail or a rack or mono-rail track of a special character—*i.e.*, a device to increase adhesion and counteract the side pull. Here, again, with an accelerated service the difficulty would be intensified, but as such a service would involve the closing of the tow-paths to the public, there would not be the same objection to a super-elevated inner or central rail, as there would be under the present system of keeping them open to the public as footpaths.

(*To be concluded.*)

GREAT INTERNATIONAL EXHIBITIONS.

(*Continued from Vol.* 61, *page* 1042.)

1900, Paris, £97,033.—Under a Royal Commission, the secretary being Col. Sir Herbert Jekyll, R.E., K.C.M.G., who filled the same post at Melbourne in 1888, and who came straight away from a command in Ireland on his appointment in April, 1897. The Government were first invited to take part on September 28th, 1895, and this invitation was accepted on June 3rd, 1896; but it was not until February 7th, 1898, that the Royal Commission was gazetted, with H.M. the King, then Prince of Wales, as its President. It may at once be said that it was the constant presence of His Majesty as its head which alone prevented the collapse of the British participation in the Exhibition. The Royal Commission consisted of no fewer than 129 members, of whom an unusually large number represented commerce and industries; 54 committees and sub-committees were formed, exclusive of the Colonies and India. The time was not opportune: the feeling between the two nations, owing to the Fashoda incident, the Dreyfus affair and the Boer War, was anything but cordial; indeed, a few months before the opening the attitude of a section of the French Press led to the wholesale withdrawal of British exhibitors and to the marked absence of British visitors during the first half of the period. The feeling thus excited then subsided somewhat; but it found an echo in the refusal of the Government to allow any of its officials to accept any decorations from the French. These strained relations were veiled to a great extent by the native politeness of the officials, but there is no doubt that they added to the difficulties of our local officials—difficulties for which scanty allowance was made, in too many cases.

Half of the total space available for the Exposition was allotted to France, and that granted to Great Britain was, on the whole and under the above circumstances, sufficient for our requirements, except as regard the Colonies, and was at least as much as had been given to any other State; the space eventually occupied by our 3,193 exhibitors was 32,512 sq. metres, as against the United States, 7,610 and 32,047; Germany, 2,696 and 33,512; Russia, 3,179 and 27,554; and Austria-Hungary, 4,341 exhibitors and 26,900 sq. metres respectively. The affair roused no enthusiasm, and there existed a general disposition to hold aloof. The Government eventually granted £125,000, but, as shown above, they did not spend it, mainly owing to a saving of £22,293 arising from a mistaken estimate of the French authorities.

Of the total expenditure, no less than £28,416 went to the Royal Pavilion, although the French shared the cost of covering the railway along the quay, and although the contractors erected it at cost price. The insurance paid on the art collection in the building amounted to £3,035, and yet the building was fireproof, and was solid enough to last as long as Kingston House, Bradford-on-Avon, of which it was in many respects a replica. It made but a poor show amongst the other towering buildings in the Rue des Nations, but it was our only opportunity for showing a really representive collective exhibit, for the exposition was cut up into classes, which gave but little space for each nation. Still, the contents of other National Pavilions were quite as valuable, and the *objets d'Art* would have, perhaps, shown up better in comparison with those from other nations in the *Grand* and *Petit Palais*. The Commissioners gave weekly receptions in it, and there was also a Commercial Intelligence bureau upstairs—the existence of which was not generally known. Under the terrace and on the quay a typical London fire brigade station was installed, instead of the restaurant originally intended.

The British Colonies, with those of other nations, and India, were relegated to the Trocadero Gardens, and were not allowed to take their place side by side with the nations of the world. This was a distinct advantage in some respects; but the space allotted to them was so small that they all retired except Canada, West Australia, the Mauritius, Ceylon and India, and even these were hampered by many delays—for instance, it was not till July 7th, 1898, that the whole of the plans showing allotted spaces were in the hands of the Commission. No charge was made for space in the main buildings, but contingent expenses had to be met partly by the Commission and partly by the exhibitors. Customs dues were not levied except on goods that remained in the country; but octroi was charged on everything and refunded on what left Paris when it was all over. The enclosures were treated as bonded warehouses, and one can better imagine than describe the trouble that all these rules entailed on everyone. Then there was the question of passes—these were of every description; the workmen's were changed once a fortnight, and were not always ready. In one case the whole of the working staff was kept outside the fences till the fresh passes arrived. Then there were the police, the traffic, and the fire regulations, and it was only by engaging Frenchmen who knew the ropes that it was possible to get on at all. In spite of these drawbacks, the displays of railway rolling stock, agricultural machinery, war materials, and ships' models, could hardly have been improved upon within the available limits of space. The P. & O. building, for instance, was a gem, second only in artistic merit to the Royal Pavilion. Our steam boilers and electrical machinery and plant for supplying motive power and light to the exhibition proved more trustworthy than any others. The makers contracted with the Administration, but the terms turned out to be so unfavourable that they lost heavily, although the Commission paid half the cost of the foundations and of transport. The railways, both in England and in the North of France, gave considerable facilities in the shape of passes, of reduced return fares, and of transport charges; owing, however, to the unpreparedness of the buildings, there were no fewer than 1,000 wagons waiting to be discharged on the opening day, April 15th, and it was not till the middle of June that all the roofs were up.

Some attempt was made at general decoration, for which £5,000 was allotted; this was not, however, very effective owing to the scattered, and more or less haphazard and higgledy-piggledy way in which exhibits were shown. On the other hand, the Indian and Colonial sections made a brave show, and "successfully challenged comparison with the displays of Foreign Powers," forming, indeed, "one of the most attractive features of the British section." All the Colonial exhibitors were charged 12s. 6d. per sq. ft. for the gross space, which sum was found adequate to defray the whole cost of building, removal of trees, fire appliances, administration, &c.; it also covered the cost of electric lighting, the British, Indian and Colonial sections being the only ones which kept open after dusk. The net expenditure on the Indian and Ceylon sections was about £25,900.

In the words of the Royal Commission:—"Taken as a whole, it cannot be said that the British Industrial Section presented a fair reflection of the industry of the country seen at its best . . . . every exhibitor used his space in accordance with his own fancy, and showed what he pleased. He provided his own showcase, and . . . . was free to indulge his own taste, subject only to the . . . . conditions imposed by the regulations. The result was anything but happy, and the contrast between the orderly, symmetrical appearance of the foreign spaces . . . . and the undignified collection of showcases of different sizes and design which filled the British space, was little less than painful."

In August, 1894, 105 British exhibitors wrote to the Home Secretary pointing out that to exhibitors at a

foreign exhibition it was above all things necessary that the executive officers and chief assistant should be in close touch and sympathy with the exhibitors throughout. From the evidence of many of these at the Paris Exhibition, in which they bitterly complained of a want of business-like organisation on the part of the executive and of too much officialism, it would appear that in 1900 this evil still existed, even after allowing for the impatience and exasperation caused by the rigid application of unwonted rules and regulations, for which the much-badgered British officials were not responsible in any way. The opinions expressed before the Departmental Committee amply corroborated those given by the Royal Commissioners in their final report, submitted on May 25th, 1901.

Finally, it may be interesting to note how the Government grant was spent, exclusive of the Pavilion and of the Trocadero Section :—Salaries and allowances, £20,282 ; wages, £976 ; office, £5,547 ; stationery and printing, £1,327 ; gratuities, £730 : grants to six committees, £10,860 ; post office, £10 ; general installation, £7,709 ; aid to electrical contractors, £2,391 ; plant, £455 ; storage of packing cases, £2,800 ; decorations, £5,459 ; police, £2,876 ; commercial information bureau, £635 ; jurors, £3,233 ; entertainments, £1,660. The salaries include subsistence and travelling allowances.

Liège, 1903. As this Exhibition was not promoted by the Government and as we did not participate in it officially, it will not be further mentioned, although it was remarkable in some ways.

St. Louis, 1904, £128,000.—Under a Royal Commission, with another Royal Engineer, Col. Sir Charles M. Watson, R.E., K.C.M.G., C.B., as Secretary and Commissioner-General, who does not appear to have had any previous experience of exhibitions. The Commission was gazetted on April 23rd, 1903, with 40 members, the Prince of Wales being president and Viscount Peel chairman. The first meeting was held on April 28th, and 17 committees and sub-committees were appointed. The exhibition was opened just a year after, on April 30th, 1904. It may as well be stated at once that the results were satisfactory on the whole, with some notable exceptions, not entirely due to the short time available for preparation. The invitation to participate was received from the United States Government in September, 1901, but it was not accepted till early in 1903, when, mainly for political reasons, the Government decided to make the largest grant that had ever been given to an international exhibition, viz., £150,000. The secretary engaged on his staff many men who had had previous experience, and this facilitated matters, although they were fearfully handicapped by want of time, by want of commercial participation, and by the Customs' demands at St. Louis.

In these and in many other ways this exhibition resembled the 1900 Exposition in Paris, while being an improvement on it. Manufacturers fought shy of it, so the Commission devoted their main efforts to collective exhibits, and were fairly successful. As in Paris, the various classes were grouped together, but the decorations of the British sections were distinctive and uniform. The Pavilion was again a source of attraction and expense. Although only made of wood covered with cement, it cost, with the surrounding gardens and including insurance, close on £32,000 ; being a reproduction of the Orangery at Kensington Palace, with two wings added ; it served for reception rooms and for offices. The whole, with a colonnade joining the two wings, was so much admired that the University acquired it for a nominal sum, as it was erected on their ground, and it is the only pavilion left standing to this day.

The following figures will be useful for comparison with those of Paris. Salaries, &c., £22,773 ; office expenses, £2,975 ; Queen's Jubilee presents, £2,180 ; exhibits, £48,123, of which £6,318 was devoted to civil engineering, machinery and electricity and transportation, £14,797 to salaries, &c., £496 to stationery and printing, and £6,578 to insurance ; freight and insurance, £1,193 ; installation and decoration, £5,840 ; storage of empty cases, £823 ; stationery and printing, £1,609 ; Metropolitan Police, £1,397, and entertaining, £1,346. On the same occasion the following amounts were expended by various other countries, viz. :—Austria-Hungary, £45,883 ; France, £22,646 ; Italy, £35,300 ; Japan, £80,466 ; and Germany, £175,000, of which the pavilion cost £64,500. The South American States also made a brave show. These are the official figures, but it has been asserted that Germany, at St. Louis, spent three times as much as we did, the Privy Purse contributing the difference. We were allotted 334,740 sq. ft,, of which the pavilion grounds occupied 120.000—the remainder being mostly taken up with the Government collective exhibits in education, art, applied arts and typography ; cloth, cutlery, steel, and machinery were not represented, except by a cotton-spinning plant shown at work by an Oldham firm—the only one in the exhibition. The distance, the expense, the high tariffs, and, above all, the worry consequent on exhibiting so many miles away, and at such short notice, acted as an effectual check on British makers of machinery, electrical and otherwise, and the few private firms who exhibited were loud in their complaints of the want of management and organisation—but it seems pretty certain that any difficulties they encountered were not the fault of the staff, but of circumstances, such as labour strikes, the gentle arts of the Custom officers, and of some of the Jurors, &c., for which the staff could not be held responsible. It is estimated that the expenditure of each commercial exhibitor on his stand averaged £193.

(*To be concluded.*)

PULVERISED COAL AND ITS INDUSTRIAL APPLICATIONS.

The subject of powdered coal as fuel has long been before the engineering public, but it has never obtained any firm hold until perhaps recently in the roasting of Port and cement, into which the ash of the coal enters as part of the cement itself, and acquires a value of, it may be, 40s. per ton. But that happens whatever fuel is used, and a dirty fuel containing 20 per cent. of ash, and costing, say, 10s. per ton, practically sells its ash as cement for nearly the price of the fuel. Dust coal, says W. D. Ennis in the *Engineering Magazine*, was used at Woolwich in puddling furnaces in 1873, and one Henschel wrote of dust fuel as far back as 1831, and many minds have since worked on the subject. A high percentage of ash is not detrimental, and grinding is seldom finer than 24 to 30 mesh. Where coal powder displaces oil fuel, the cost of fuel may be halved, but where it displaces lump fuel, any saving is to be looked for in labour and better efficiency.

Fine coal can only be used otherwise in the form of briquettes, but if it is sufficiently volatile and it be reduced to powder, it will float in a current of air and burn like a gas. Indeed, what is the flame of hydrocarbon gas but burning hydrogen loaded with light particles of carbon? Thus the flame of a dust cloud of coal. In burning such dust there is air all round the particle of dust, and combustion is perfect, given time, space, and temperature conservation. Finely powdered coal flashes like gunpowder if lightly sifted upon a flame from above.

There is some risk with dust coal in regard to fire, especially with fuel high in volatile matter; grinding ought not too long to precede use, and the processes of drying and grinding should be kept away from the furnaces. Fire insurance men regard dust fuel as less dangerous than liquid fuel.

Our author says that coal for use as powder should contain over 30 per cent. of volatile matter, and therefore anthracite or semi-bituminous coals cannot be burned as dust, though they may be burned if mixed with rich dust. There must be flame if dust is to be burned, and apparently the flame must carry oxygen, and be hot enough to cause the carbon to combine with the oxygen. Coal with less than 20 per cent. of volatile matter will not, says Mr. S. H. Hall, ignite. With 35 per cent. ignition was easy. Less rich coal will ignite if the combustion chamber be heated in advance. Several examples of coal and their results are given. In one case where there was 3·5 per cent. of moisture the ash showed 2·74 per cent. of volatile, 1·78 per cent. of fixed carbon—a poor result, due to the excess of moisture. A long-flaming moisture-free coal is what is necessary for the best results. The drier the coal, the easier it is to pulverise. But it is not to be considered that pulverising offers a cheap and certain method of utilising mine wastes. In one works using dust fuel, coal of 1¼ in. size is bought for furnace work, and the screenings are ground. It costs, according to W. H. Bryan, 35 cents to grind a ton of coal, and this is offset by labour saving in the boiler house, but our author does not think that the cost of grinding can assuredly be considered as covered by labour economised.

Pulverising includes three processes—one to reduce all to nut size, drying, and a third process of final grinding. The ground coal then goes to bins, whence its feed to the furnace is regulated together with the air supply. Drying prevents "snowball" adhesion effects, permits better regulation of supply and better air mixture, each bit of dust being separate and independent. It is also safer against spontaneous ignition. Drying of coal costing 12s. per ton ought

not to exceed 3d. per ton. Ordinary driers are externally fired rotating cylinders with internal ribs to lift and drop the coal.

Sometimes the hot furnace gas may reach the coal after it has been reduced in temperature. The hot dry gas passes along inside the cylinder, ventilating the coal and carrying off its moisture. A 6-ton per hour drying cylinder, 4 ft. × 27 ft., will dry down from 10 or 12 to 1 per cent., and will require 5½ H.P. to drive it and its fan.

Counter current drying is practised with all dryers. The fuel used is 1 to 1½ per cent. of that dried. Thus, assuming 10 per cent. as initial moisture, 1 ton (2,000 lb.) will lose 200 − 20 = 180 lb. in drying out to 1 per cent. This represents 173,880 B.TH.U. of latent heat. Coal of 12,000 B.TH.U. capacity represents, if 1 per cent. or 20 lb. be burned, a dryer efficiency of 72 per cent. Coke may very safely be used as the drying agent, for it has no long flames.

If the drying gases are found to condense out moisture on the coal to be dried, this may be remedied by using a greater excess of air so as to reduce the humidity of the effluent stream of gas. Tube mills or ball mills may be used for pulverising. In England the "devil" disintegrator seems to have been used, but is not referred to. The tube mill is claimed to grind to less than 1·96 per cent. on a 100-mesh screen or even to 3·22 per cent. on a 200-mesh, but tube mills are hard to drive, one only 60 in. by 17 ft. at 23½ R.P.M, demanding nearly 60 H.P. Various roller mills have been tried, such as the Griffin, but they all appear clumsy non-positive devices, and in the writer's opinion, a positive grinder would do better work with less power, but no word is said on positive grinders.

At one works, to drive a three-roller mill requires 34 H.P. for 5 tons per hour, or 4·2 per cent. of the output in equivalent horse-power. There seems to be an uncertainty in the pulverising by these various roller mills, and they are said to require a sieving process subsequent to the grinding and a return of the coarser material to the mills. In positive grinding no sieving is requiring.

In a ball mill with hardened balls and cast-iron races, a capacity of 3½ to 4 tons per hour, grinding to 95 per cent. on a 100-mesh sieve, is claimed for 32 to 35 H.P. Some makers adopt air separation for the ground coal, so as to reject all but the dust, a settling chamber being used to collect the dust, the degree of fineness being regulated by the speed of the fan, the economy of fineness ceasing where superior efficiency ceased to equal the cost of of the finer pulverisation. Nothing is said as to the settling chamber, but in England this has been built from flannelette, a teased up soft cotton fabric which freely allows air to pass through, but holds back the finest coal dust in a really wonderful manner. Cost of grinding increases rapidly with fineness, and the coal is said to be difficult to grind. An outside figure for cost is 1 horse-power for 100 lb. per hour, and this figure may be halved. Coal, when ground, lies at a natural slope from the vertical of 34° to 38° if dry. Its specific gravity is 1·3 to 1·35.

Conveyors to feeding trains should have end overflows, in order to avoid packing. Small lines should be used, and storing must not be practised for long, for though the loss of weight is small the loss of heating power is great.

The author, unfortunately, has nothing to say of the dust problem. Some of the ash of powdered coal will run liquid from the furnace, but this liquidity will not characterise all the ash, and some of it will escape into the flues and some will even get away by the chimney top. It is difficult to imagine that dust fuel can be employed in some places, at least unless there is a settling chamber to deal with the dust, and probably also special arrangements to clear the flues of dust. But if this difficulty can be overcome, powdered coal is capable of good results and perfect combustion.

TRANSFORMER TROUBLES.

THE voice of the operating engineer is not often heard in the land; at any rate, not in the technical Press. He is too often wholly engaged in consigning (carriage forward) to the torrid zone those constructional engineers, who have so designed his central station, that much hard work and versatility is necessary in order to cause the plant to keep in operation.

A very fruitful source of trouble in the high-tension alternating-current system is the transformer—apparently a simple-looking object, it conceals a considerable amount of original sin; and the vagaries of transformers in parallel are apt to cause a considerable amount of what is technically known as mental strain to the operating staff of a generating station.

With the increasing cost of copper and the wide extent of transmission areas, the central station transformer now assumes a most important position, and if we may judge by an article in the *Canadian Electrical News* by M. A. Sammett, the future troubles in store for English engineers, as trans-Atlantic practice becomes more general over here, are numerous. A generator is a very simple thing to manage, inasmuch as with proper adjustment of field current these machines will, when running in parallel, divide the load proportionally. In these days of turbine drives and power factor meters, the regulation of the generating plant is a simple matter.

When we come to the transformer, however, the case is different. In order that transformers may divide the load equally, or in proportion to their rated capacities, it is necessary not only that their primary and secondary voltages should be the same, but that they should have the same impedance. This is where the constructional man often lays a pitfall for the operator. Not one, but several cases have been known where transformers, apparently of the same size, type and make, have been put into parallel, resulting in a tale of woe, and complaints from consumers. The trouble has probably been that the transformers were built at different times, and lightly guaranteed to run in parallel with plant already supplied. For example, a case is recorded where a bank of transformers thrown together without preliminary test runs on the strength of the makers' guarantee, owing to pressure of time, burnt out disastrously. Belated testing showed that the new transformers had an impedance of 3·58 per cent., while the old transformers had 4·4 per cent., resulting in an overload on the new transformers of 19 per cent. Hence an intrinsic gain from the manufacturer's point of view resulted in considerable loss and damage to the station.

It is, therefore, always necessary to experimentally test the impedances of all transformers before putting them on load, to log the results, and if transformers for the same duty do not have the same impedances, corrective reactance coils must be put into circuit to bring up the values to their proper amount.

With the increase in size of central stations and the consequent enlargement in capacity of transformers, it has been necessary to provide these auxiliaries with plant auxiliary to them. In the earlier days transformers were so designed as to depend on unassisted radiation in order to dispose of the heat generated in the interior of the windings. It soon became feasible, however, to cut down the capital cost by artificially cooling the transformer, either by air blast, oil cooling, or water circulation. The natural draught transformer for central station work is now practically obsolete. The air blast and water-cooled transformers offer both advantages and disadvantages. Air blast transformers have the disadvantage that they accumulate dust with considerable ease. This is objectionable in transformers of high voltages, such as 10 000 or 20,000 terminal pressure. Moreover, it is found in this type of transformer that the temperature of the upper portion of the coils is often much in excess of the average coil temperature. When transformer coils are connected on top the air passages are frequently blocked, and the temperatures often attain such a point as to make it unsafe to further operate the transformer. Moreover, the presence of a strong blast of air rapidly carries flame from one transformer to another should a burn-out occur. Even the means adopted to keep the transformer clean—the use of compressed air for blowing—is, unless this is carefully carried out, a source of danger. Unless the air is perfectly free from moisture insulation may be considerably weakened and great trouble may ensue.

The disadvantages attendant on the use of oil-insulated water-cooled transformers are, firstly, the possibility of the water getting at the winding, and, secondly, the chance of the oil decomposing and forming a thick non-conducting mass. The first may be due to a defective water coil, or a coil which is allowed to have water in it during the winter months, while the transformer is not in use. Water coils should stand a pressure of 200 lb. per sq. in.; care should be taken to efficiently connect the coils to outside piping, and during the winter months transformers not in operation should have the water removed by an air-pump or replaced by oil under pressure. The decomposition of transformer oil takes place at high temperature only. It is not safe to let the transformer temperature exceed 70° C., as a sample of oil subjected to 90° C. formed a heavy deposit in two weeks. Sometimes the temperature of this type of transformer begins to rise without any obvious reason. It may be due to the ageing of the iron, resulting in a higher iron loss, or to decomposition of oil, or to clogging of the water-cooling coils. In one case, where the water was carried to the brass cooling coils through an iron pipe, the water, which was slightly acidulated, first attacked the iron and then deposited the iron in the form of a sediment, which reduced the coil opening to one-third of its normal size.

Where transformers are used outside the central station for transforming high pressure down to low pressure, they will, if of moderately large dimensions, be liable to troubles arising either from unequal division of load on parallel operation, unequal division of load on three-phase delta connections and phase transformation. As before, the variability of impedance in different transformers of the same general size and type gives rise to the first difficulty. It is well to make it a rule not to operate small transformers in parallel, but to keep secondaries separate whenever possible. This will prove beneficial not only for the purpose of getting over operation difficulties, but from considerations of actual economy. Single-phase transformers, when connected on polyphase circuits for the supply of polyphase currents should possess the same characteristics with regard to division of load as single-phase transformers on single-phase circuits, *i.e.*, their impedances must be the same. In phase transformation from two to three-phase or *vice versa*, it is generally understood that the three-phase circuit requires the middle point of one transformer to be connected to the 86 per cent. point of the other. This, while holding good for small type transformers, will not apply to core transformers unless special provision is made for the interlinkage of both primary and secondary windings. In small sizes of 50 KW., and under, the shell type is a failure, and the core type is the recognised standard for both lighting and motor service. The core type gives maximum ease in insulating the high from the low-tension coils, and, whenever possible, the coils should be wound on a perfectly circular form to give freedom from short-circuiting the winding at the bends.

The chief points which will ensure satisfactory operation of transformers are, then, the liberal provision for overload conditions in the first outlay on plant; the proper understanding of the performance of the apparatus under normal and also emergency conditions; the retention of the core type for small service transformers; and the keeping of proper records of transformer impedances in order to ensure proper parallel operation.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

29,689A/06. "Improvements in retarding devices or dash-pots, more especially intended for use with electric circuit-breakers." W. H. SCOTT. (Date applied for under Rule 5 of the Patents Rules, 1905, December 29th, 1906.) December 16th.

29,689B/06. "Improvement in connection with electric circuit-breakers or switches." W. H. SCOTT. (Date applied for under Rule 5 of the Patents Rules, 1905, December 29th, 1906.) December 16th.

11,594A. "Improvements in and relating to electric motors specially adapted for rolling mills." ALLGEMEINE ELEKTRICITAETS GES. (Date applied for under Patents Act, 1901, May 21st, 1906, being date of application in Germany. An invention comprised in application No. 11,594 dated May 17th, 1907.) December 18th. (Complete.)

1,099A. "Improvements in and relating to electric switches." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) (Date applied for under Rule 5 of the Patents Rules, 1905, January 15th, 1907.) December 21st.

27,672. "Improvements relating to the driving of electric cranes and the like." H. PIEPER. (Date applied for under Patents Act, 1901, December 28th, 1906, being date of application in Belgium.) December 16th. (Complete.)

27,681. "Improvements in electric resistances." W. F. JONES. December 16th.

27,682. "Portable electric burglar alarm and the like." C. J. AYLEN. December 16th.

27,723. "Improvements in and relating to gasoliers and electroliers for gas and electricity." S. QUINCEY and C. HARRISON. December 16th.

27,735. "Improvements in or relating to radio-active preparations and apparatus for use thereof." A. J. BOULT. (Radiogen G.m.b.H. Germany.) December 16th. (Complete.)

27,736. "Improvements relating to the suspension of wires, cables, ropes and the like." P. J. PRINGLE and G. W. GREEN. December 16th.

27,739. "Arc lamp with a support electrode with which the other electrode is rigidly connected." F. JANECEK. (Date applied for under Patents Act, 1901, December 20th, 1906, being date of application in Germany.) December 16th. (Complete.)

27,763. "Invention to discharge the electricity produced in spinning and drawing wool and other textile fabrics." H. PRIESTMAN. December 17th.

27,764. "Improved helm signal telemotor apparatus." W. G. GIBBONS. December 17th.

27,768. "Renewable electric accumulator terminal." J. HOOLEY. December 17th.

27,783. "Improvements in means for making electrical joints or connections." C. W. DENNY. (C. C. T. Eastgate and D. J. Horn, India.) December 17th. (Complete.)

27,790. "Improved process and apparatus for oxidising atmospheric nitrogen by electricity." D. HELBIG. December 17th. (Complete.)

27,792. "Improvements in or relating to electrical switches." H. W. COX. December 17th.

27,809. "Improvements in and relating to incandescent electric lamps." E. C. R. MARKS. (Parker-Clark Electric Co., United States.) December 17th. (Complete.)

27,821. "Process of and apparatus for the creation of magnetic fluxes." C. G. GUERCIN. December 17th.

27,830. "Improvements in electrolytic cells." A. E. GIBBS. December 17th. (Complete.)

27,841. "Improvements in clock-controlled mechanism for operating electric switches or other devices at predetermined times." A. M. STUART and E. J. WILLIAMS. December 17th.

27,849. "Improvements in single-phase motor control." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 17th.

27,852. "Improvements in and relating to secondary batteries." H. DURHAM. December 17th.

27,857. "Improvements in electrically operated switches." A. ECKSTEIN and A. C. HEAP. December 18th.

27,864. "Improvements in the manufacture of electric incandescence lamps." THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., and E. A. GIMINGHAM. December 17th.

27,879. "Improvements in or relating to magnetic electric machines." H. W. VAN RADEN. December 18th.

27,891. "Improvements in or connected with electrically-signalling or communicating messages or signals to vehicles running on rails." W. BARNETT. December 18th.

27,901. "Process and apparatus for inducing, taking and transmitting without a wire magnetic fluxes." C. G. GUERCIN. December 18th.

27,924. "Improvements in and relating to dynamo-electric machines." A. H. MIDGLEY. December 18th.

27,925. "Improvements in and relating to sparking plugs for internal combustion engines and the like purposes." A. H. MIDGLEY. December 18th.

27,926. "Apparatus for welding rings, hoops, chain-links and the like by means of an electric current." ALLGEMEINE ELEKTRICITAETS GESELLSCHAFT. (Date applied for under Patents Act, 1901, January 4th, 1907, being date of application in Germany.) December 18th. (Complete.)

27,933. "Improvements in testing apparatus for magneto-electric spark ignition apparatus." G. A. UNTERBERG and F. HELMLE, trading as Unterberg and Helmle. (Date applied for under Patents Act, 1901, October 17th, 1907, being date of application in Germany) December 18th. (Complete.)

27,937. "Improvements in and relating to single-phase alternating-current electric motors of the commutator type." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 18th.

27,951. "Sick room electric light." J. H. HILL. December 19th.

27,953. "Improvements in and connected with devices for killing rats and other animals by electricity." W. C. MORRISON. December 19th.

27,971. "Improved contact maker for synchronising firing and distributing high-tension current in twin cylinder explosion engines." E. KICKHAM. December 19th.

27,986. "Improvements in electric time switches." G. LUTHI. December 19th. (Complete.)

27,989. "Improvements in and relating to electric railway installations." E. WOLTMANN. December 19th. (Complete.)

28,003. "Improvements in loose-handle single-pole electric breakers." S. WHIPP, F. WHIPP and C. BOURNE. December 19th. (Complete.)

28,014. "Improvements in and relating to magnetic separating machines." THE RAPID MAGNETTING MACHINE CO., LTD., H. H. THOMPSON and A. E. DAVIES. December 19th.

28,015. "Improvements in and relating to magnetic separating machines." THE RAPID MAGNETTING MACHINE CO., LTD., H. H. THOMPSON and A. E. DAVIES. December 19th.

28,030. "Process of and apparatus for the transmission of energy by a single wire." C. G. GUERCIN. December 19th.

28,040. "Improvements relating to the control of alternating-current electric induction motors and of the means driven thereby." H. A. MAVOR and MAVOR AND COULSON, LTD. December 19th.

28,042. "Improvments in or relating to electrical heating apparatus." H. T. HARRISON. December 19th.

28,044. "Method of mounting commutators and other structures upon driving spindles." A. TYSON-WOLFF. (H. L. Tyson-Wolff, India.) December 19th.

28,062. "Improvements in electric switches." J. C. MEREDITH, LTD., H. A. MEREDITH and J. W. EWART. December 20th.

28,080. "Improvements in electric measuring instruments." W. MOSELEY. December 20th.

28,081. "Improvements in telephone transmitters." W. MOSELEY. December 20th.

28,100. "Improvements in prepaid electric meters." W. B. THORPE. December 20th.

28,106. "Improvements in storage battery plates." A. O. TATE. December 20th. (Complete.)

28,111. "Improvements in supports for electric and other lamps." J. N. FROST. December 20th.

28,117. "Improved method of manufacturing artificial plates for insulating and other purposes." E. WEIDINGER (née Dresser) and H. KAHN. December 20th. (Complete.)

28,132. "Improvement in storage battery plates." A. O. TATE. December 20th.

28,133. "Improved thermal device for use in protecting electrical circuits carrying alternating, polyphase and direct-currents." A. H. CURTIS. December 20th. (Complete.)

28,137. "Improvements in alternating-current electric motors of the induction types." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 20th.

28,138. "Improvements in and relating to electric lamps." ALLGEMEINE ELEKTRICITAETS GESELLSCHAFT. (Date applied for under Patents Act, 1901, December 27th, 1906, being date of application in Germany.) December 20th. (Complete.)

28,142. "Improvements in sparking plugs for internal combustion engines." THE SIMMS MANUFACTURING CO., LTD., and A. H. D. ALTREE. December 20th. (Complete.)

28,143. "Improvements in and relating to the generation, control and transmission of electric energy particularly applicable for use on automobiles and the like vehicles." A. H. MIDGLEY. December 20th.

28,151. "Improvements in long-distance and wireless telephony." W. MOSELEY. December 21st.

28,164. "Improvements in the traction wheels of electric tramcars." MOUNTAIN & GIBSON, LTD., and W. RENISON, JUN. December 21st.

28,175. "Improvements in arc lamps." F. M. LEWIS. December 21st.

28,199. "Improvements in connection with electric circuit breakers." W. H. SCOTT. December 21st.

28,201. "Improvements in spark plugs." J. LANG. December 21st. (Complete.)

28,212. "Improvements in electrical locking apparatus for railway signals." J. A. HOFFE and G. H. JELFS. December 21st. (Complete.)

28,218. "Improvements in and relating to electric apparatus for generating current and for starting up the machinery of automobiles." A. H. MIDGLEY. December 21st.

28,220. "Improvements relating to starting means for vapour electric devices." P. H. THOMAS. (Date applied for under Patents Act, 1901, December 24th, 1906, being date of application in United States.) December 21st. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1906.

APPARATUS FOR THE CALCULATION OF THE CORRECT SIZE OF CABLES OR WIRES USED FOR THE TRANSMISSION OF ELECTRIC POWER, OR FOR THE SOLUTION OF SIMILAR MATHEMATICAL PROBLEMS. Callender's Cable & Construction Co. and A. P. Ackery. 27,683. December 5th.

ELECTRIC ARC LAMPS HAVING MUTUALLY INCLINED CARBON HOLDERS. J. Brockie. 27,726. December 5th.

VENTILATION OR COOLING OF DYNAMO-ELECTRIC MACHINES. W. Armistead. 27,762. December 6th.

ELECTRICAL FITTINGS, BOTTLE STOPPERS, AND THE LIKE. A. Waltho. 28,687. December 15th.

ELECTRIC ARC LAMPS. A. D. Jones. 23,286. October 20th.

MEANS FOR THE REGULATION OF THE SPEED AND POWER OF ELECTRIC SHOCKS. H. Leitner. 23,889. October 26th.

CONDUITS FOR LAYING ELECTRIC CABLES. C. G. Warne. 26,810. November 26th.

APPARATUS FOR PRODUCING OXIDES OF NITROGEN BY ELECTRIC PROCESS. T. Mosciçki. 27,006. November 28th. (Date applied for under International Convention, August 8th, 1906.)

ELECTRIC DISTRIBUTION SYSTEMS ESPECIALLY APPLICABLE TO ELECTRIC RAILWAYS. British Thomson-Houston Co. and J. E. Woodbridge. 27,902. November 30th.

ELECTRICAL HEATING APPARATUS. A. Reynolds. 27,421. December 1st.

ELECTRIC LAMP PLUG. R. B. Chouler. 27,556. December 4th.

ELECTRIC ARC LAMPS. O. Gross. 27,569. December 4th.

MANUFACTURE OF INCANDESCENCE ELECTRIC LAMPS. C. H. Stearn and C. F. Topham. 28,680. December 15th.

1907.

ELECTRIC PRIMARY BATTERIES. J. T. Szek. 8,660. April 15th.

ELECTRIC CONDUCTORS FOR USE IN CONNECTION WITH INSTALLATIONS OF ELECTRIC LIGHT. G. Davis. 12,711. June 1st.

SYSTEM OF CONTROLLING AND OPERATING MOTORS FOR ELECTRIC RAILWAYS AND POWER PLANTS. J. Sahulka. 13,140. June 6th.

TENSION ADJUSTMENT FOR ELECTRICAL BRUSH GEAR. T. S. S. Marshall. 14,418. June 22nd.

CONTROL OF ELECTRIC MOTORS. Allgemeine E'ektricitäts Ges. 14,440. June 22nd. (Date applied for under International Convention, June 23rd, 1906.)

DRIVING GEAR FOR ELECTRIC TRAMCARS. V. C. Lironi. 15,219. July 2nd.

METHOD OF ELECTRIC LIGHTING FOR LIGHTHOUSES, BEACONS OR BUOYS. C. A. Stevenson. 16,301. July 16th.

CONDUITS, PARTICULARLY CONDUITS FOR ELECTRIC TRAMWAYS. W. Manders and G. Hodge. 16,732. July 22nd.

MEANS FOR ATTACHING ELECTRIC CONDUCTORS TO CARBON BRUSHES. M. W. Robertson. 18,462. August 15th.

PRODUCTION OF TUNGSTEN DIOXIDE. Westinghouse Metal Filament Lamp Co. 18,922. August 22nd. (Date applied for under International Convention, November 23rd, 1906.)

APPARATUS FOR USE IN CONNECTION WITH ELECTRIC WAVE TELEGRAPHY. R. R. Osman. 19,077. August 24th.